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IRCUWU 2019

The Centre of excellence for Value Addition

Uva Wellassa University

International Research Conference 2019

INTERNATIONAL RESEARCH CONFERENCE | 2019

"Sustainable Business Transition through Technology and Innovation"

7-9, FEBRUARY

Uva Wellassa University of Sri Lanka

IRCUWU 2019

International Research Conference - 2019

"Sustainable Business Transition through Technology and Innovation"
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Badulla
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The International Research Conference of Uva Wellassa University (IRCUWU 2019) leaves a fantastic memory in the history of Uva Wellassa University which would not have been a reality without the contribution, devotion and well wishes of a multitude number of personalities.

Vice Chancellor, the Chairman of the Research Committee and the Organizing Committee IRCUWU-2019 extend their sincere gratitude to Hon. Sujeewa Senasinghe, Minister of Science, Technology and Research for gracing the IRCUWU 2019. The Ministry of Science, Technology and Research, Uva Provincial Ministry of Tourism and The National Science Foundation collaborated as Co-sponsors of IRCUWU 2019 by contributing significantly in making this endeavor a success.

A special appreciation is extended to the Guests of Honour Professor (Dr.) Noel Scott and Senior Professor (Dr.) H.H.D.N.P. Opatha, two Keynote Speakers Prof. Shuichi Asakawa and Dr. Karin Müller together with moderators and panelists for sharing their invaluable expertise with us.

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Last but not least, sincere appreciation goes to all the committed Academic, Administrative and Non-academic Members of Uva Wellassa University together with all those who actively engaged in the IRCUWU 2019.

IRCUWU 2019

UWU has generated an exemplary studious milieu for the nation inspired by unique theme, "Value Addition to the National Resources Base" and UWU continues to produce well rounded graduates capable of contributing to the national development with innovative solutions.

With the prime objective of expanding knowledge horizons while paving way towards sustainable national development, UWU takes pride in opening its International Research Conference (IRCUWU, 2019) under the theme of "Sustainable Business Transition through Technology and Innovation". This esteemed intellectual forum aims at bringing together Researchers, Scientists, Engineers, Social Scientists, Economists, Scholars, Students and Professionals, Allied Stakeholders to exchange and share their experiences, novel ideas and research findings in all aspects of science, engineering and management sciences and discuss the challenges encountered and the practical solutions adopted. Further, the program includes Internationally Renowned Speakers who will address a wide spectrum of current trends, improvements, issues and challenges. For IRCUWU 2019, eight hundred and eighty-seven (887) abstracts were received from local and international researchers. The abstracts went through a thorough reviewing and editing process resulting in only 592 presentations, respectively under the following tracks.

1. Aquaculture & Fisheries
2. Biodiversity & Conservation
3. Bioprocess Technology
4. Computing & Information Sciences
5. Entrepreneurial Agriculture
6. Entrepreneurship & Organizational Development
7. Environmental Science
8. Food Science & Technology
9. Genetics and Biotechnology
10. Hospitality & Events Management
11. Humanities & Social Sciences
12. Library Science & Information Management
13. Marketing, Accounting & Finance
14. Material & Mineral Sciences
15. Mechanical Engineering & Mechatronics
16. Sustainable Animal Production Technology
17. Sustainable Crop Production Technology
18. Travel & Tourism

Conference Tour to Mahiyangana Temple will take place on the day 3. Mahiyangana Raja Maha Temple claims for a very important place in the history of Buddhism in the island, as it is the location of the Buddha's first visit to Sri Lanka nine months after attaining enlightenment and finally a short tour to Dambana and Sorabora Lake with a Cultural Show, which is the massive irrigation reservoir of ancient Bintanne located about 1Km away from the current Mahiyangana town.

Chancellor's Message

I would like to make this opportunity to wish you all the very best at this promising gathering of scholars and their futuristic thinking on the International Research Conference 2019, Uva Wellassa University on "Sustainable Business Transition through Technology and Innovation"

Technology makes the world a better place by making human more developed in their lifestyles and their rate of innovation will make more marvels in technology. Innovation and the technology alone will not make a favourable surrounding. Sustainability will generate a better environment for the present as well as for the future generations. Hence, the change of innovation and technology on sustainable business would construct a safe journey towards the long-life of the mankind. The International Research Conference of Uva Wellassa University 2019 brings scholars together to share knowledge while enhancing the thinking of human which will finally influence the human evolution for a sustainable world.

This conference is a platform to exchange knowledge and the experiences of scholars to enhance their thinking pattern towards sustainability of the world. It is a significant occasion of academic endeavours. Uva Wellassa University will be the Centre of Excellence for Value Addition and creating a learning atmosphere to build the basement for the upcoming entrepreneurs in Sri Lanka. In addition, I take this opportunity to express my blessings to the Vice Chancellor, Academic Staff, Non-academic staff, and the Students in making up this academic forum a success.

Most Venerable Bengamuwe Sri Dammadinna Nayaka Thero
Chancellor
Uva Wellassa University
Badulla
Sri Lanka

Vice Chancellor's Message

It is with great pleasure and pride, I am forwarding this message on the occasion of the International Research Conference 2019, one of the most significant annual events of the Uva Wellassa University.

The successful blend of various researches carried out in different specialization areas will allow the industry to view value addition through various arenas. Thus, I believe that the International Research Conference of Uva Wellassa University - 2019 leading the theme "Sustainable Business Transition through Technology and Innovation" aims at bringing together Researchers, Scientists, Engineers, Social Scientists, Economists, Scholars, Students and Professionals, Allied Stakeholders to exchange and share their experiences, novel ideas and research findings in all aspects of science, engineering and management sciences and discuss the challenges encountered and the practical solutions adopted. Further, International Research Conference of Uva Wellassa University – 2019 openly invite all to disseminate their novel knowledge by organizing 18 tracks representing the sectors such as Management, Science Technology, Agriculture and Humanities.

I am sure by working together as a team would be able to take the University to the pinnacle of its glory. I invite all to participate and provide your scholarly contribution at this remarkable occasion.

In conclusion, I wish to express my sincere gratitude to the Organizing Committee and Uva Wellassa University family for their untiring efforts in making International Research Conference of Uva Wellassa University – 2019 a success.

Prof. (Dr). J.L. Ratnasekera
Vice Chancellor
Uva Wellassa University
Badulla
Sri Lanka

Research Committee Chairman's Message

It is with great pleasure I would like to forward this message on the occasion of the International Research Conference of Uva Wellassa University (IRCUWU 2019) which is held under the theme of "Sustainable Business Transition through Technology and Innovation". Also, I congratulate the organizing committee members of IRCUWU 2019 for taking the challenge to host this event successfully.

Since the inception, Uva Wellassa University takes the responsibility of producing graduates who could make a significant contribution to the economic development of the country upon the completion of their study programmes of Uva Wellassa University. Thus, it provides entrepreneurial education together with other core subjects for all undergraduates in their respective curricula delivering the knowledge and skills requested by the employers of the industry. The theme of the University – Value Addition to National Resources Base – has been put forward with the impression of making this contribution to the economy.

The theme, "Sustainable Business Transition through Technology and Innovation", of the IRCUWU 2019 demands the sustainable use of resources while undertaking business with innovative ideas linking advanced technologies. Therefore, it should aim a sustainable development without degrading the resources while trusting on innovation and technology. I believe that the set theme of IRCUWU 2019 has led the research community in particular within the University to bring forward with innovative ideas and technological advancements which could help have a sustainable development.

It can be expected that IRCUWU 2019 will provide a platform for graduating students and other scholars to present their valuable research findings and interact with experts in the sector, peers, and prospective stakeholders. Also, this will no doubt provide an opportunity to enhance the research culture within the University. More importantly, the research findings presented by research community of the University will witness the progress and contribution of Uva Wellassa University especially in research and related activities.

I expect all participants and presenters will have a valuable time through active participation to the IRCUWU 2019.

Prof. (Dr). H.M.S.K. Herath
Chairman/Research Committee
Uva Wellassa University
Badulla
Sri Lanka

IRCUWU 2019 Coordinator's Message

Technological innovation contributes to higher levels of economic output and can deliver new goods and services that change human lives and capabilities. Pioneer Entrepreneurial as well as Techno-preneurial University in Sri Lanka, UWU has its unique theme of "Value Addition to the National Resources Base" to generate an exemplary studious milieu in order to add value to the nation.

Additionally, UWU continues to produce well rounded graduates capable of contributing to the national development with innovative solutions. With the prime objective of expanding knowledge horizons while paving the way towards sustainable national development, UWU is proud to host its International Research Conference- 2019 under the theme of **"Sustainable Business Transition through Technology and Innovations"** where it attempts to fill the gab which has been awaited by the industry. The objective of the esteemed intellectual forum IRCUWU-2019 is to deliver a platform for scholars, researchers & knowledge seekers to discuss, share and disseminate knowledge under eighteen tracks on invaluable findings of current research while opening new paths towards sustainable development of Sri Lankan economy especially through technology & innovations.

Success of the IRCUWU-2019 would not be possible without the diligent effort and dedication of all academics and non-academics of the Uva Wellassa University. Hence we are indebted to all who contributed to various activities to make this event success. I specially would like to thank Prof. (Dr). J.L. Ratnasekera, the Vice Chancellor of Uva Wellassa University for the guidance given to organize this huge event. I would like to thank track coordinators and event coordinators for their enormous support, continuous interest and constructive suggestions to conduct the IRCUWU 2019 successfully. Special thanks to reviewers and editorial board members who contributed immensely. Finally, I would like to appreciate all the sponsors and supporters for their invaluable contribution rendered to make this event a success.

It has been a great privilege for me to serve as the Coordinator of IRCUWU-2019 and wish the event to be a remarkable success footprint within research and publications in worldwide.

Dr. J. Sutha
Coordinator / IRCUWU 2019
Uva Wellassa University
Badulla
Sri Lanka

Chief Guest's Message

I am pleased to extend my heartfelt greetings to The International Research Conference of Uva Wellassa University 2019. With the theme, "Sustainable Business Transition through Technology and Innovation", Uva Wellassa University has set a novel direction in higher education by emphasizing scientific research and development to certify improved excellence and productivity so as to upgrade economic activities. I firmly believe that a colloquium of scholars to present and discuss concurrent research findings would undoubtedly contribute to the ongoing economic development from various perspectives. With the main objective of creating Sri Lanka a scientifically and technologically advanced nation and the fertile ground created by IRCUWU 2019 will make the achievement easier. In order to ensure the guiding principle of making research relevant to national development goals, the Ministry also continued to accord the highest priority to create a link between research, research funding and development priorities. In this backdrop Uva Wellassa University has taken praiseworthy and timely measures to introduce more research oriented education to the undergraduates. It is inspiring to observe the outcomes of numerous research spread over a broad spectrum of disciplines are being deliberated at this pinnacle event. Hence, I strongly believe IRCUWU-2019 will be an educative platform for scholars all over the world to share their knowledge.

Hence, I congratulate all the presenters who will share their findings at the International Research Conference 2019. I wish the IRCUWU 2019 all the success in opening up avenue to achieve its objectives and to contribute towards economic development of the country.

Mr. Sujeewa Senasinghe
Minister of Science, Technology and Research
Sri Lanka

Speech of Guest of Honour

It is my great pleasure to be the Chief Guest at the Uva Wellassa University Annual Research Symposium, and to address the conference theme of "Sustainable Business Transition through Technology and Innovations". Uva Wellassa University emphasises technopreneurship highlighting the pivotal role of science and technology in creating a prosperous country and successful careers for its graduates. There is no doubt about the impact that science and technology have on all facets of society. This impact is transforming traditional sectors such as agriculture, manufacturing and services.

Indeed, the area in which I conduct research, tourism, has been revolutionised by new technology. In 2017, there were 1.3 billion international travellers, due in no small part to the commercialization of the jet engine and the extraordinary growth of the global economy. Sri Lanka is set to benefit economically from these developments through the rapid growth of its tourism sector.

Our society generally and tourism specifically has been transformed using the internet, email, social media and online commerce. I can remain in contact with my family and friends and be 'at work' no matter my physical location. My photos, impressions and thoughts can be instantly transmitted to an audience of followers. I can book and pay for a flight to Colombo, a hotel room in Galle or a tour of an elephant sanctuary with my smartphone. Augmented reality can be used to learn about a tourism destination and I have experienced Sigiriya in virtual reality. In my own research, I use psychophysiological sensors to find out how potential travellers react to such experiences. Universities have a critical role in the diffusion of such innovation to government, business and the population at large.

Along with the benefits of new technology go new problems such as increased CO2 pollution, plastic waste and pressure on scarce resources. Perhaps this is a useful area for future research and development. Recently I have been working on the reuse of plastic waste as filament for 3D printers. There are also opportunities for reuse of plastics as building material and in road construction. Other areas discussed during this conference include solar energy, smart technology, and biotechnology. Uva Wellassa University can play a pivotal role in developing such technologies and transferring its use to the people of Sri Lanka. This research symposium provides a forum for discussing these issues and I wish it every success.

Professor (Dr.) Noel Scott
University of the Sunshine Coast,
Australia
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Speech of Guest of Honour

Sustainability and Organizational Ethics: An Innovative Management Thinking

Prof. H.H.D.N.P. Opatha

Senior Professor
University of Sri Jayewardenepura

Introduction

First I take this opportunity to thank the Chair and members of the Organizing Committee of International Research Conference 2019 of Uva Wellassa University of Sri Lanka for inviting me to deliver this address as the Guest of Honour. The purpose of my address is to discuss first, the meaning and importance of sustainability and organizational ethics and then, present a practical framework for ethical decision making. I consider the framework which will be presented to you as an innovative management thinking.

There is a compelling reason for goals of the organization to be expanded to address current challenges being faced by HR Managers and other managers in contemporary organizations that are increasingly expected to serve not only owners and other direct stakeholders (customers, employees, and suppliers) but also society and environment. In the modern world, it is a must for every organization and every manager to be concerned with making significant and positive contributions to environmental, social, and economic performance of the organization. Sustainability is the most important issue that you and I have to deal with now and will have to deal with in the future too.

Sustainability

According to the literature the most widely used definition is the definition given in the report titled "Our Common Future" prepared by the World Commission on Environment and Development (1987, as in Rompa, 2011), and it is: *sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. Three fundamental components of sustainable development, i.e. the economic growth, the environmental protection, and social equity were highlighted by the Commission. A sustainable future is badly expected and it needs to be economically viable, environmentally sound, and socially equitable.
It is indeed that sustainability has a broad focus on environmental, social, and economic performance of organizations, and therefore it is a **broad view** of environmental, social, and economic results which are favourable for the world. It is because of that the needs of people today and needs of future generations are taken into consideration under sustainability it is a **long-term perspective**. It is an **umbrella term** that covers a lot of ideas and actions towards minimizing or avoiding adverse environmental and social

effects of operations of business organizations. Of course it is an **ultimate goal** to be achieved by every organization and every manager for the betterment of humans and non-humans.

Here I would like to present the working definition of sustainability which was specially developed by me (Opatha, 2016) so as to include our concern of non-human beings:
"Deliberate constant endeavour to utilize human and other resources, and natural environment to meet needs of current human beings as well as non-human beings while maintaining and if possible enhancing human and other resources, and natural environment to meet needs of future human beings and non-human beings."

It has been generally observed that the unlimited and greedy pursuit of economic performance by firms contributes to numerous and enormous environmental problems and profits are maximized at the expense of natural environment. There is a compelling need to stop this in order to avoid the situation in which we all will be in serious troubles including those owners who get constant maximized profits. It is true that consideration of environmental and social aspects into business decisions and operations and engaging in certain sustainable actions and programs require additional and considerable effort, time, and money on the part of the organization. Being sustainable is not natural and it is deliberate and expensive. However, one must ascertain that survival of the organization and its stakeholders depends on the survival of the environment. According to research clear business reasons exist for sustainability (Opatha, 2019). Also there is moral case for environmentally sustainable business practices. Opatha (2019, p. 7) writes:

"A business organization gets the license to operate its business so as to do the pursuit of a fair profit. It has no license given by the members of the society to maximize profits by doing any harm to general well-being of the people in the society and the Earth in which people live. If business operations advertently or inadvertently do any harm to society and the Earth, the business organization becomes responsible for that. Hence, morally a business organization is obligatory to act as a responsible corporate citizen."

American Management Association (2007) summarizes that the modern concept of sustainability has evolved from mostly separate streams of parallel conversations into a holistic notion that rejects the premise that social-environmental and economic issues are competing interests; and this, new, integrative perspective contends that social, environmental, and economic performance can and must be optimized simultaneously for both short-and long-term success. According to Daft (2014) although doing the right thing might not always be profitable in the short run, many managers believe that it can provide a competitive advantage by developing a level of trust that money cannot buy. A sustainable enterprise does creating and enhancing trust and loyalty within its employees, customers, and suppliers resulting in that employees retain until their retirements, customers revisit and repurchase, and suppliers continue on supplying various inputs.

According to a research done in 2010 by the Economist Intelligence Unit, the most important motivation for promoting sustainability policies is "*do the right thing ethically*". As per Table-1 that shows the results of the 2007 AMA/HRI Sustainability Survey (by using 1,365 respondents), there are 18 sustainability-related issues and the most important sustainability-related issue is '*Business ethics and integrity*'.

Table-1: Results of the Survey about the Importance of Sustainability-related Issues

On a scale from 1-5, how important are the following sustainability-related issues to you personally, and how important do you think are to your company?					
Issues	Rank	You Personally	Rank	Your Company	Difference
Business ethics and integrity	1	4.77	1	4.46	0.31
Safe and healthy work environment	2	4.68	2	4.31	0.37
Affordable quality health care	3	4.66	4	4.00	0.66
Well-being of employees	4	4.64	5	3.87	0.77
Clean water	5	4.43	7	3.67	0.76
Corruptions in all its forms	6	4.43	3	4.24	0.19
Worker job security	7	4.40	8	3.57	0.83
Safe and reliable food sources	8	4.36	12	3.38	0.98
Human rights abuses	9	4.22	10	3.46	0.76
Affordable clean energy	10	4.13	9	3.50	0.64
Assistance after natural disasters	11	4.10	6	3.73	0.37
Poverty and homelessness	12	3.94	13	3.17	0.77
Climate change	13	3.90	15	3.13	0.77
Epidemics	14	3.82	11	3.42	0.40
Diverse ecosystem	15	3.81	14	3.14	0.67
Open immigration	16	3.37	16	2.97	0.40
World population growth	17	3.36	18	2.85	0.52
Right to collective bargaining	18	3.23	17	2.92	0.32

Source: AMA/HRI (2007)

Organizational Ethics

In a general sense, ethics is the code of moral principles and values that governs the behaviors of a person or group with respect to what is right or wrong (Daft, 2014). Ethics are principles about right and wrong or good and bad behavior of the individuals or groups (Silva and Opatha, 2015).

Opatha (2019, 88) defines:
"The application of ethics to behaviour of personnel in a particular organization refers to as **Organizational Ethics**. When general ethical principles are applied to organizations it is called as organizational ethics. **Organizational ethics includes a set of moral principles about right and wrong that needs to be followed by individuals and groups of the organization when making decisions.** Organizational ethics is a critical aspect of the organizational management that consists of **the moral values, beliefs, and rules which are utilized to govern the way employees are supposed to behave when dealing with parties inside and various parties outside the organization and when making**

decisions individually and collectively. Alternative terms for organizational ethics are **business ethics** and **managerial ethics**."

Many pages will be required to show the importance of organizational ethics if actual cases where evil consequences occurred owing to unethical behaviour are specifically written. Opatha (2019, p. 90) stresses:

"It has generally been observed in Sri Lanka that incidents such as giving promotions to unqualified persons, appointment of personnel for top positions on political influences, unnecessary foreign trips and local functions, sexual harassments, bullying behaviours, retaliations, evil conflicts, assassinations, character assassinations, assaults, abuse of public properties, receiving various gifts and gratifications by assigning contract work to relatives, friends or associates, receiving a high commission on the basis of purchasing various assets or properties at higher prices for government or organization, and misappropriation of public funds occurred. In fact, by the time of writing this Chapter, the plight has been getting increased. It is more likely that future Sri Lankan society will be distressing and full of problems including serious damages to the natural environment unless a serious intervention by way of application of organizational ethics is not made."

A big challenge is how to ensure the adherence to organizational ethics in an organization? What are the critical ethics to be adhered? Here I will focus only on Normative Ethics, not on Meta Ethics. Normative ethics is the branch of philosophy that is concerned with prescribing certain moral attributes, norms and rules to apply for decision making and it has two sub types, i.e. *virtue ethics* and *rule-based ethics*. Exhibit-1 gives definitions of ethics.

Exhibit-1: Definitions of Ethics

Type	Definition
Virtue Ethics	Virtue ethics are about personal character qualities for being morally good. Examples of personal virtues include patience, self-discipline, tolerance, humility etc. while social virtues include honesty, respect, loyalty, gratitude, benevolence, caring etc. Vices include jealously, deception, desire for others' things, greed, selfishness, anger, hostility, reprobation, retaliation, lust etc.
Rule-Based Ethics	
Teleological Rules	Teleological rules derive from teleology or utilitarianism which is a philosophical approach that attempts to do the greatest good for the greatest number of people. It has the objective of doing the greatest good for the greatest number of people. Under this approach, when attempting to decide what right or wrong behaviour is, the consequences of the decision should be the focus.
Deontological Rules	Deontological rules derive from deontology which is a philosophical approach that attempts to ensure certain **universally accepted principles** such as honesty, fairness, privacy, safety, and respect for humans. Deontology focuses purely on the intrinsic rightness of an action, without regard

	for its consequences (Robinson, n.d.). It has the objective of promoting the absolute necessity of duty, irrespective of the rewards or punishments that may follow.
Justice Rules	Justice rules derive from justice approach. According to Daft (2014) the justice approach holds that moral decisions must be based on standards of equity, fairness, and impartiality.
Human Rights Rule	Human rights rule derives from human rights approach which is a generally accepted very influential view that stresses that all human beings have basic human rights which must not be violated. Some rights include (1) **The right of privacy** (right to choose own life style off the job; to deny access to information about private affairs),(2)**The right of freedom of conscience** (right to refuse something you consider as immoral or against your religious beliefs),(3) **The right of free consent** (right to treat a person as he or she freely consents to be treated), (4) **The right of free speech** (right to speak freely about issues including the right to criticize others on ethical and legal grounds without infringing the rights of the others), and (5) **The right of due process** (right to have a fair and impartial hearing).
Liberty Rule	Liberty rule is that the only restriction on behaviour should be preventing harm to others and unless the actions harm others, people should be free to do as they please (based on material by Mac and Calis, 2012).
Care Rule	Care rule is that an action is right if it cares for those individuals with whom the decision maker has a special relationship; and it is alternatively called ***Caring Theory*** (based on material by Gusdorf, 2010).
Stakeholder Rule	Stakeholders are the people who have a stake in how an organization performs, and whose interests are affected significantly by activities of the organization. They are basically internal stakeholders (owners, employees, and the board of directors) and external stakeholders (customers, suppliers, government agencies etc.). Stakeholder rule is that an action is right if it is useful for all stakeholders concerned in some significant way. If an action is harmful to at least one major stakeholder it is unethical.

Source: Based on material by Opatha (2019)

The Role of HRM

Human Resource Management (HRM) plays a critical role in creating and enhancing employee ethicality which is the extent to which employees utilize the moral values, beliefs, and rules when dealing with parties inside and various parties outside the organization and when making decisions individually and collectively. Employee ethicality is the extent to which employees in the organization think, decide, act and react ethically. Ethicality can exist at two levels: (1) individual level, which can be labelled as 'personal ethicality' and (ii) group level, which can be labelled as 'collective ethicality'

(Silva, Opatha, and Gamage, 2016). HRM functions can be performed by incorporating ethical matters so as to make employees ethical. Exhibit-2 presents ways of making employees ethical under respective HRM functions.

Exhibit-2: Ways of Making Employees Ethical under HRM Functions

HRM Function	Ways of making employees ethical
Job Analysis	• To include ethical dimension as a duty in Job Description. • To include ethical competencies as a special component in Job Specification.
Recruitment	• To include ethics-related criteria in the recruitment messages. • To communicate the employer's concern about ethics through recruitment efforts.
Selection	• To select applicants who are sufficiently aware of ethics to fill job vacancies. • To select applicants who have been ethical as citizens under their private life domain.
Hiring	• To include ethical standards expected from the new employee in a pledge, explain and get it signed. • To include ethical standards expected from the new employee in the letter of appointment.
Induction	• To make new employees familiar with ethics and organizational efforts in making employees ethical. • To develop induction programs showing ethical behaviour of current employees.
Performance Evaluation	• To evaluate employee's job performance according to ethics-related criteria. • To include a separate component for progress on ethicality in the performance feedback interview.
Training	• To impart right knowledge and skills about ethics (normative ethics, meta-ethics, unethical behaviour, etc.) to each employee through a training program exclusively designed for making ethical. • To do training needs analyses to identify training needs of employees in respect of ethics.
Pay Management	• To integrate ethical standards, in addition to performance levels when considering pay. • To connect 'input equity' of pay to ethical performance and ethical competence.
Incentives Management	• To give financial incentives to employees for their ethical performance of job. • To give non-financial incentives such as praises and recognitions to employees for their ethical behaviour.
Welfare Management	• To provide certain welfare services such as time-off services, advances and loans, and transport services to only those who are ethical.

Management of Employee Promotions	• To consider ethicality of the employee as a main criterion for giving promotions. • To appoint members who are highly ethical to promotion committees.
Discipline Management	• To formulate and publish rules of conduct relating to ethics. • To develop a progressive disciplinary system to punish employees who violate the rules with regard to right and wrong.
Grievance Management	• To allow whistle-blowing. • To appoint an ethics officer to deal with claims of unethical behaviour.

Source: Opatha (2019, pp. 120 and 121)

Human Resource Manager or the Head of the Department of Human Resources in an organization can become an ethical maven and as an ethical maven, he/she needs to play four roles which include advocate, builder, leader and practitioner (Opatha, 2019). As an Advocate he/she is required to make the case that ethicality is an essential competence of performing jobs and doing business for betterment of all stakeholders. As a Builder he or she is required to help identify and construct the knowledge and skills needed to make ethicality a core competence of all the responsible people in the organization. As a Leader, he or she is required to lead and motivate employees (managers and non-managers) in order to ensure that their behaviour is ethical. As a Practitioner, he/she is required to lead by example by improving his/her own ethical competence.

Ethical Dilemmas

Today management problems are not simple and managers will have to face ethical dilemmas which are complex and which cannot be settled easily and shortly. A systematic and objective attempt was made by the author to develop a practical framework for ethical decision making and this framework was originally developed in 2010 and an extended version of the same was developed and published in 2019 in his book titled Sustainable Human Resource Management. Appendix 1 gives the framework which is in fact the published material in the book (pp. 108-117).

Conclusion

Sustainability has become the most important issue to be dealt with by all of us. It has a profound effect on thoughts and behaviour of every manager/professional in future as they should be in line with it. One of the most important areas or practices of sustainability is organizational ethics and without the ethicality of everyone who makes decisions in an organization the achievement of sustainability becomes seriously hampered, perhaps impossible. A practical framework with twelve criteria such as personal character, utilitarianism, deontology, justice, human rights, liberty, care, stakeholder, disclosure, reversibility, happiness, and the most virtuous person-in-belief were presented for the purpose of ethical decision making: ethical dilemmas. The author believes that the framework possesses a high level of utility.

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Sri Lanka.

Keynote Speech 1

A Novel Strategy for Genome Analysis of Non-Model Sexually Reproducing Organisms.

After finishing of human genome analysis, next generation sequencers (NGS) were developed. The NGSs enable us to analyse whole genome of any organisms easily with lower cost. However, assembling of the reads generated from sexually reproducing (usually diploid) organisms by short massive parallel sequence such as Illumina Hiseq results in formation of large number of short scaffolds/contigs. To improve these situations, we have established a new strategy for genome assembling, generation of linkage map and ordering of scaffolds/contigs. We utilized artificially generating fish with haploid genome (haploid or doubled haploid) as starting material of genome sequencing. Haploid genome does not contain heterogeneous genome, which is very helpful to form longer scaffolds/contigs. The organisms with haploid genomes are also very useful for development of very high-resolution linkage map. Furthermore, we further developed the method to generate very high-resolution linkage map by using artificially designed hybrid organisms. In addition, to perform generating linkage map and ordering of scaffolds/contigs effectively, we establish novel software, Scaffold Extender with Low Depth Linkage Analysis (SELDLA). In this conference, we present our strategy of genome analysis of non-model sexually reproducing organisms.

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Keynote Speech 2

The Natural Capital Value of Soil: Soil Carbon, Architecture and Water Repellency

The natural-capital concept integrates ecological principles with economic values by considering nature's stocks of materials and energy as capital. Nature comprises an aggregation of different natural capital stocks including soil and water. The natural capital stocks are interrelated and form a structural landscape system, also termed the 'ecological infrastructure'. Soil is a key component of this ecological infrastructure. It provides many ecosystem services to the benefit of humans and supports human well-being. In 2005, the Millennium Ecosystem Assessment classified ecosystem services into four classes: the supporting services of soil formation and nutrient cycling, the provisioning service of food, forage, fuel and fibre production; the regulating services that buffer and filter water, carbon and gases; and the cultural services of heritage, recreation and spiritual well-being. This classification highlights that ecosystem services are valuable not only to the owners of the land resource but also to the wider community and in fact, in the end to all humans. For example, Costanza et al. (2014) estimated that the global value of ecosystem services averaged 125 trillion $US year-1 in 2011, which is a reduction between 4 and 20 $US trillion year-1 compared to 2007 (depending on the method used). The reduction was attributed to land use change and to the decrease in the global coral reef area. This highlights that global degradation of natural capital stocks threatens to reduce the ecological infrastructure's capacity to provide beneficial services to humans.

In this presentation I will focus on the regulating services of soils and will show how investments into natural capital can enhance the delivery of ecosystem services. Soil organic carbon is the key soil property in my presentation. Soil organic carbon is underpinning many ecosystem services that soils are providing. The interrelationship between soil biotic activity, soil organic matter decomposition and stabilisation, and soil aggregate dynamics has been recognised and intensively studied for decades. Soil architecture and organic matter are not independent from each other: soil pores are created by abiotic and biotic factors such as root growth, burrowing, drying and wetting cycles. In turn, the pore network forms the habitat for soil biota, and pore characteristics including their size, tortuosity and connectivity influence organic matter dynamics. As such they also affect the soil's regulating services in relation to nutrients, water and gases. Positive correlations between soil organic carbon contents and soil water repellency have been reported, and the effect of soil water repellency on soil water dynamics and the regulating services of soils also needs to be taken into account. In summary, investing carbon into

the soil's natural capital can lead to returns in the form of sustaining and enhancing the flow of the regulating services of soils.

I will share a few case studies from New Zealand: First, I will show how trees and vines can increase the soil's carbon content down to great depths – in one particular case study, up to a depth of 9 m. A kiwifruit orchard in the Bay of Plenty on an Andosol sequestered 6.3 t organic carbon ha-1 year-1 more than the adjacent pasture block on the same soil and under the same climate. This is carbon that was not emitted to the atmosphere contributing to greenhouse gas emissions but that positively affected the soil's architecture. The kiwifruit vines extended the zone of carbon well down the soil profile. There are multiple soil management practices that can increase soil organic carbon contents. I will discuss a few that are used in orchards in New Zealand.

I will then show with a couple of case studies how carbon investments can benefit the soil's regulating services by altering the manageable properties of the soil's natural capital, including, for example, its connected macroporosity, labile carbon content, and soil water repellency. All these properties affect the nutrient, gaseous and water regulating services that flow from the soil's natural capital. The case studies will demonstrate how we can quantify changes in pore structure resulting from the feedback mechanisms between organic carbon management and soil biota using 3D X-ray computed tomography, and how such changes can explain differences in the regulating services provided by soils. I will also introduce our new method to quantify soil water repellency and show that the relationship between soil water repellency and soil water content can be predicted using vis-NIR spectroscopy. The case studies highlight how investment of carbon into the natural capital soil can provide valuable returns on the investment made.

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Effect of Sesame Seed Cake Meal as an Alternative Protein Source in the Diets of Juvenile Guppy Fish Reared in Outdoor Farming Conditions

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Replacing expensive fish meal component in fish feeds using alternative protein sources is necessary for sustainable aquaculture industry. A six week feeding trial was carried out to evaluate the effects of inclusion levels of sesame seed cake meal (SS) to replace commercial fish meal (FM) in diets for Guppy (*Poecilia reticulata*) reared in outdoor tanks. Four experimental diets were prepared and control diet (CD) contained 18% FM and 0% SS. The other three diets were 10SD (10% SS + 8% FM), 15SD (15% SS + 3% FM) and 20SD (20% SS + 0% FM). Additionally, a commercial diet (ED) was also used as one treatment to compare growth, feed performance and survival of fish. Fish (0.06 ± 0.01 g and 1.80 ± 0.11 cm) were randomly allocated across 15 cement tanks (120 x 90 x 40 cm) at a stocking density of 80 fish m^{-3} with three replicates per treatment and fed adlibitum three times per day for 6 weeks period. Final total length was significantly higher in fish fed on 10SD (3.18 ± 0.18 cm), 15SD (3.12 ± 0.23 cm) and 20SD (3.14 ± 0.24 cm) diets compared to fish in CD (2.92 ± 0.22 cm) and ED (3.00 ± 0.19 cm) treatments. Percentage SGR of fish were significantly higher in all SD treatments and ED treatment compared to control treatment. Feed consumption (% Body weight day^{-1}) and FCR were ranged from 5.31± 3.08 to 5.67 ± 3.51 and 1.29 ± 0.06 to 1.41± 0.12 for SS included diets respectively. Fish fed on CD and ED diets showed higher feed consumption (% Body weight day^{-1}) and FCR values than SS included diets. Fish in SD treatments showed better growth performances and feed utilization without any negative effects on their survival compared to fish fed on commercial feed. Total cost (1 kg) of ED was Rs 250 while cost for the other four diets were Rs 176, 149, 136, 127 for CD, 10SD, 15SD and 20SD respectively. Present study indicates that sesame seed cake meal can be successfully included up to 10-20% as a low cost alternative protein source in practical diets for guppy reared in farm conditions.

Keywords: Sesame seed cake, Fish meal, Guppy, Gow cost feed

Molecular Identification of Fresh and Cooked Tuna Samples Using Triplex-Polymerase Chain Reaction Assay

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During trade and processing of tuna products, it is very important to detect commercial frauds regarding substitution of species. As a consequence, a guarantee can be given to the consumers about the safety and origin of the tuna product. Identification of the correct tuna species is important to detect and prevent food adulterations. The main objective of this project is to differentiate most available tuna species of yellowfin, bigeye and skipjack tuna from other fish species in fresh and cooked samples using triplex PCR method. DNA was extracted from fresh samples by salt method and from cooked samples by DNeasy mericon food kit (Qiagen). Fish specific PCR was carried out to confirm that the samples are actually belonging to a fish species and to check the quality of the DNA for the amplification purpose due to the presence of PCR inhibiters especially in the cooked samples. Band size of 251 bp was obtained for all fish samples as expected and band sizes of 284 bp, 140 bp and 242 bp were obtained for yellowfin, bigeye and skipjack tuna respectively in triplex PCR. Out of 10 fresh tuna samples five were identified as adulterated samples and no PCR product was obtained for non tuna samples as expected. Cooked tuna samples labeled as yellowfin and skipjack produced expected bands, and the product labeled as "tuna ambulthiyal" detected as skipjack. Product labeled as "fish ambulthiyal" and the rest of the cooked fish samples were not obtained any band which demonstrated the tested samples not belongs to the yellowfin, bigeye or skipjack. Therefore, this assay can be used successfully for the identification of adulterated fresh and cooked tuna samples and did not get any band for other fish samples which confirm that this assay was specific for above mentioned tuna species.

Keywords: Triplex PCR, Fish specific PCR, Fresh and cooked tuna samples, Molecular identification

Sea Urchin Abundance and Diversity at Selected Locations in Southern and Eastern Coasts of Sri Lanka

H.B.U.G.M. Wimalasiri, D.G.T.C. Balawardhana and S.S.K. Haputhanthri

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Sea urchins are a vital group of herbivores in both temperate and tropical food webs because they control macroalgal cover, and consequently influence primary productivity and phase shifts on reefs. Sea urchin gonads is a delicacy in many countries. Due to the commercial value, sea urchin has identified as a cultivable marine invertebrate species. This study aims to identify the abundance and diversity of sea urchin at five selected sites in the southern (Midigama, Kottegoda, andNilwella) and eastern coasts (Pulmudei and Trincomalee) of Sri Lanka. The study was carried out using Random transect sampling method and transects were vertical to shoreline with the length varying from 5m -20m at the selected sites to estimate the sea urchin abundance during January to August, 2018. At the field, a quadrate of 0.5m x 0.5m was laid along transects all the sea urchin species were counted within the plot. Density and diversity of Sea urchin in two regions were estimated, and their means were compared.According to the results, a total of 12 sea urchin species were detected among the five sampling sites. On the Southern and Eastern coast, sea urchin abundance is recorded as 18individuals m^{-2}, and 10 individuals m^{-2} respectively. Shannon Weinner index of diversity is highest in Midigama in Southern coast than other locations. Dominant species was *Stomopneustes variolaris*(Black sea Urchin) both in eastern and southern regional coasts. The abundance of *S. variolaris* was significantly higher in the Southern Coast compared to Eastern coast ($P<0.05$). If Sri Lanka initiated commercial catching of sea urchins, special management measures would be needed to prevent overexploitation of sea urchins. It is recommended to study other aspects of sea urchins including reproductive biology and stock size estimation. This study would provide some baseline information for the management of sea urchin population around Sri Lanka .

Keywords: Sea urchin, Abundance, Diversity, *Stomopneustes variolaris*

Suitability of Plant Based Ingredients: Rice Bran, Coconut Poonac and Maize as Binders for Quality Improvement of Fish Feed Additive Made from Autolyzed Shrimp Waste

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Discarded shrimp shells, a good source of natural astaxanthin, proteins and lipids can be used as a feed additive to enhance colouration and growth of ornamental fish. Temperature-induced autolysis of shrimp waste breaks the chitin-protein bonds and releases these nutrients. Hydrolysate extracted by autolysis is sticky and perishable at room temperature (30 °C). The main Objective of this study was to improve quality and shelf life of shellfish waste extract using plant-based ingredients as binders. Shellfish waste (100 g) was subjected to thermal autolysis at 55 ^{0}C for 15 minutes with continuous stirring. Resultant Hydrolysate was mixed with powdered rice bran, coconut poonac and maize separately in different ratios of hydrolysate: plant ingredient (1:1, 1:2 and 1:3) each in triplicates. Protein and moisture content were determined in oven-dried samples. Samples at room temperature were checked for changes in physical properties (colour, stickiness, odour) and fungal formation (clotting) once a week for one-month period. Highest crude protein percentage was observed in samples of 1:1 hydrolysate: plant ingredient ratio (rice bran: 38.13±8.20%, coconut poonac: 47.83±3.75% and maize: 36.76±5.74%) with significant differences (P=0.002) of treatments among three binders. Protein content and stickiness reduced with increasing binder content. Rancid odour, colour change and clotting were minimal during this time period with highest binder content (1:3). Moisture percentage was significantly different (P<0.05) among samples of 1:1, 1:2 and 1:3 ratios and lowest (9.54±1.79) in samples with 1:2 ratio prepared using coconut poonac. Coconut poonac with highest protein and lowest moisture content is advantageous than other two binders. As there is no difference observed in physical properties in three ingredients, maize and rice bran are also suitable as binders. Selection of plant ingredient and suitable ratio depend on protein level and storing period of additive as required by farmer.

Keywords: Fish feed, Feed binders, Feed additives, Temperature autolysis, Shellfish waste

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Comparative Study on Total Chlorophyll, Carotenoid, Fucoxanthin in Seaweeds *Ulva reticulata, Sargassum ilicifolium* and *Gracilaria multipartita* and Colour Enhancing Commercial Ornamental Fish Feeds

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Seaweeds are photosynthetic marine macro algae, contain various natural colour pigments. Considering high bioavailability and low cost of processing, this study aimed on evaluating the potential of using seaweeds as a feed additive for colour enhancement of ornamental fish compared to commercial colour enhancing ornamental fish feeds by assessing three types of pigments. Three algae species (green algae-*Ulva reticulata*, brown algae-*Sargassum ilicifolium* and red algae-*Gracilaria multipartita*) were collected from Dickwella area. Pigments were extracted into 10 ml of 99% acetone from sun-dried algae and from 3 types of commercial feeds having green, brown and red colours. Total chlorophyll, carotenoid and fucoxanthin content of seaweeds and commercial feeds were quantified using UV spectrophotometer. Non-normally distributed data were analyzed by Kruskal Wallis test in Minitab version 17 at 0.05 significant level. Highest total chlorophyll content was observed in *U. reticulata* (70.50±0.39 µg g^{-1}) & *S. ilicifolium* (59.53±4.34 µg g^{-1}) and it was significantly different from their respective colour feeds (green 4.57±1.63 µg g^{-1} and brown 7.69±5.56 µg g^{-1}). Similarly, *U. reticulata* and *S. ilicifolium* had significantly different carotenoid content (1.44±0.16, 2.11±0.07 µg g^{-1}) compared to their respective colour feeds (green 0.22±0.09 µg g^{-1} & brown 0.21±0.07 µg g^{-1}). Chlorophyll & carotenoid content had no significant difference between *G. multipartita* and its respective red colour feed. Fucoxanthin content was also higher in seaweeds (*U. reticulata* 2.12±0.89 µg g^{-1}, *S. ilicifolium* 4.69±3.05 µg g^{-1} and *G. multipartita* 1.52±0.82 µg g^{-1}) than three commercial feeds (green 1.82±1.81 µg g^{-1}, brown 0.53±0.33 µg g^{-1} & red 0.49±0.06 µg g^{-1}) with no significant difference. Results indicate that sun-dried seaweeds contained comparatively high level of pigments studied; the selected sea weeds may be taken as an effective feed additive for the colour enhancement of ornamental fish.

Keywords: Pigment extraction, Seaweeds, Ornamental feed, Chlorophyll, Carotenoid

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Assessing the Ecological Impact of the Bottom-set Crab Net Fishery for *Portunus pelagicus* on Non-Target Species at Thuraiyoor, Sri Lanka

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The bottom-set crab net *Portunus pelagicus* fishery has been recently developed and is now one of the top livelihoods of Thuraiyoor fishermen, which is located in Jaffna District inside the Palk Bay. The crab net fishery seems to be ecosystem friendly when compared with trawling. However, a better understanding of the ecological impact is lacking in the Sri Lankan context. This study aimed to quantify the total bycatch, determine the catch composition of non-target species and examine the likely impact of the fishery on non-target species. Data were collected using a fishery dependent survey. From the total catch observed from the 152 net-sets, 45% of the catch was targeted catch and 55% was bycatch. The resulted proportion of bycatch as valuable bycatch (*i.e.* retained) and discarded bycatch were 40% and 15% respectively. Based on fishery dependent surveys, a total number of 84 non-target species were observed in the bycatch. The bycatch included 32 species of fish, 23 species of crustaceans, 18 species of mollusks, 9 species of echinoderms and 2 species of cnidaria. Among the total bycatch, spider conch (*Lambis lambis*) comprised 30% of the total catch by weight and identified as a main species. The remaining 25% included all other non-targeted species and the majority were mollusks and crustaceans. The automated Marine Stewardship Council (MSC) vulnerability score and MSC overall score for spider conch were as 2.35 and 89 respectively, which is equivalent to an Unconditional Pass of the MSC Fishery Standard for Sustainable Fisheries. Consequently, this study at Thuraiyoor supports earlier studies in the Palk Bay, which indicate that the ecological impact on the non-target species by bottom-set crab net *P. pelagicus* fisheries in the Palk Bay is a low conservation concern at present.

Keywords: Bycatch, *Portunus pelagicus*, Bottom-set crab net, Palk bay, Sri Lanka

Comparative Analysis on Morphological Variation of Three Populations of *Saccostrea cucullata* (Rock Oysters) and *Crassostrea madrasensis* (Indian Backwater Oyster) (Bivalve: Mollusca) in Selected Coastal Regions of Sri Lanka

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Crassostrea madrasensis (Indian backwater oyster) and *Saccostrea cucullata* (Rock oyster) are abundant shellfish varieties with higher culture potential along coastline of Sri Lanka. Limited research studies are available on population clustering and distribution patterns of Oysters in Sri Lankan coast. This study was focused to analyze intra-specific morphological variation among 03 populations of *C. madrasensis* and *S. cucullata* in Sri Lanka. *C. madrasensis* samples were collected from Panadura, Trincomalee and Kalpitiya coasts, while *S. cucullata* samples were collected from Dickwella, Jaffna and Mt'Lavinia during August-December 2018. Ten morphometric parameters were measured using 190 samples and standardized morphometric measurements were subjected to Discriminant Function Analysis (DFA). Two discriminant functions were derived by predicted two models for populations of *S. cucullata* (Function 1: Wilks'ƛ=0.005/Function 2: Wilks'ƛ=0.81, P<0.05) and *C. madrasensis* (Function 1: Wilks'ƛ=0.35/Function 2: Wilks'ƛ=0.82, P<0.05). Derived first Discriminant functions were identified as strongest factors by highly accounting for models of *S. cucullata* and *C. madrasensis* with of 99.9% and 85.8% of total variances respectively (Eigen values: 164.55 and 1.34). The ratio between Adductor Muscle Scar Height of Right Valve/Adductor Muscle Scar Area {AMSH(R)/Area} was selected as the highly contributing parameter on strongest function in extracted models of *S. cucullata* (0.68) and *C. madrasensis* (0.52). The group plots derived for *S. cucullata* indicated overlapping between two populations in Colombo and Jaffna, while population of Dickwella illustrates a clear separation from other two groups with intra-specific variation. Group plots of *C. madrasensis* records overlapping of populations with morphological similarity and three groups consider as one population. This study provides basic information on population structure of *S. cucullata* and *C. madrasensis* in Sri Lanka. Population genetic studies are recommended to confirm the findings of this study.

Keywords: Morphological variation, Oysters, Discriminant Function Analysis (DFA), Morphometric characters, Coastal zone

Development of Low Cost Mass Culture Media for *Spirulina platensis*

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Spirulina platensis is an algae popular as a food supplement with high protein content. The pure cultures of *Spirulina* are maintained using Zarrouk medium, which cannot be used for mass culture as the medium is highly expensive. The present study aims to develop a low cost mass culture media suitable for commercial scale culture of *S. platensis* in Sri Lanka. Three culture media [T1 (w/w)-$NaHCO_3$:73.68%, NaCl:8.77%, Urea :10.96%, Albert solution:4.38%, T2 (w/w)-$NaHCO_3$:75.4%, NaCl:7.18%, Muriate of Potash:4.39%, Triple Supper Phosphate:1.79%, Urea:11.22%, T3 (w/w) -Triple Supper Phosphate:0.95%, $NaNO_3$:7.18%, Muriate of Potash:4.96%, NaCl:47.91%, $MgSO_4$:0.71%, $CaCl_2$:0.19%, $NaHCO_3$:38.33%] were formulated by incorporating selected fertilizers and other cost-effective alternative chemicals, while Zarrouk medium was used as the control. Three media were tested in triplicates for growth performance of *Spirulina*. One-unit volume was used from a pure culture with 1100 cells ml^{-1} and inoculated in to all the treatments. Cultures were initiated in an axenic batch culture method in the formulated media and maintained under the illumination of 4000 lux and at 35°C temperature. The growth rate of culture was measured by counting the number of cells under light microscope and cell ratio was calculated. Data were collected once in three days for 15 days and data were statistically analyzed by one-way analysis of variance (ANOVA) Results revealed the significantly high numbers of cells (186.24±25.76 cells ml^{-1}) in T3 followed by control 123.21±3.10 cells ml^{-1}, T1 114.80±27.97 cells ml^{-1}, T2 96.92±3.69 cells ml^{-1} ($P<0.05$). Hence, T3 medium was identified as the most favorable media for the growth of *S. platensis*. The highest growth rate was also observed in T3 medium during the 15 days culture period. According to the cost analysis, T3 medium was three times cheaper than the Zarrouk's medium and can be recommended for initiating mass culture of *S. platensis* in Sri Lanka.

Keywords: *Spirulina platensis*, Growth, Zarrouk medium, Mass culture media

A Study on the Potential of Extraction of Roe Oil from *Thunnus albacares, Katsuwonus pelamis, Canthidermis maculata* and *Lepidocybium flavobrunneum*

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Fish oil contains essential polyunsaturated long chain fatty acids which are crucial for normal growth and survival of the fish. Food fish roe and fish waste contain oils in different levels. Even though roe of food fish has a lower demand in Sri Lanka, there is a potential of extracting edible fish roe oil and fatty acids. In this study, five different oil producing methods; heat and salt extraction, enzymatic hydrolysis, mechanical pressing and solvent extraction were tested with selected four fish species (*Thunnus albacares, Katsuwonus pelamis, Canthidermis maculata* and *Lepidocybium flavobrunneum*) to identify the best method and best fish roe type for edible roe oil production. Solvent extraction with 2-propanol was found to be the best method of producing roe oil considering oil yields (1.48±0.70 g: *T. albacares*, 1.33±0.10 g: *K. pelamis*, 1.27±0.25 g: *C. maculata* and 1.01±0.01 g: *F. flavobrunneum*). Hence, solvent extraction method was carried out for the selected matured roe of four species using four types of solvents: (50ml) 2-propanol, hexane, acetone and mixture of hexane and 2-propanol (70:30). Oil yields of roe in different maturation stages were (using 2-propanol) measured and compared. Highest oil yields were recorded by matured roe of (*K. pelamis*: 1.18±0.14 g, *T. albacares*: 1.03±0.32 g, *L. flavobrunneum*: 1.01±0.01 g and *C. maculata*: 0.94±0.52 g). Oil yields of immature roe in all four fish species were negligible. The results showed a significant difference between oil yields and solvents used for extraction ($P<0.05$). Highest oil yield was obtained (25 g of matured roe) as 1.60±0.26 g with acetone extraction for *T. albacares* followed by 2-propanol: hexane mixture, 2-propanol and hexane solvents were recorded oil yields of 1.43±0.89 g & 1.18±0.14 g for *K. pelamis* and 0.64±0.17 g for *T. albacares* respectively. It was revealed that roe of *T. albacares* is the most suitable for extraction of roe oil.

Keywords: Roe oil, Solvent extraction, Maturation

Abundance and Diversity of Ichthyoplankton in the West Coast of Sri Lanka, from Kelani River Estuary to Maha Oya Estuary

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Fundamental understanding of fish resources has become an urgent need in Sri Lanka for the sustainable management of fish stocks. As studies on ichthyoplankton (fish eggs and larvae) in Sri Lankan coastal waters are scarce, a preliminary study was carried out with the aim to find the abundance, distribution and composition of ichthyoplankton in the west coast. Samples were collected in five stations bordering Kelani river estuary, Negombo lagoon and Maha *Oya* estuary in the west coast where human interactions are relatively high. Horizontal surface sample and a vertical sample were collected from each station using Working Party 2 (WP2) plankton net (180 µm mesh size) for three months in 2018: March, September and October representing 1st inter-monsoon, Southwest monsoon and 2nd inter-monsoon respectively. Fish eggs and larvae were separated from plankton and identified to the lowest possible taxonomic level under the stereo microscope using the standard keys. A total of 4095 fish eggs and 465 fish larvae belonging to 23 families were collected from the study area. An average abundance of 8772 eggs and 996 larvae per 1000 m^3 were recorded. Most abundant taxonomic level in each month were, Family Siganidae in March, Family Blennidae in September and Order Clupeiformes in October. The highest abundance of fish eggs was found in Station 3 (22158 per 1000 m^3 in vertical sample and 13934 per 1000 m^3 in horizontal surface sample) and larvae was found in Station 4 (1196 per 1000 m^3 in vertical sample and 2537 per 1000 m^3 in horizontal surface sample) which is located adjacent to Maha *Oya* estuary, showing estuaries' ecological services as nursery grounds for early stages of fish. This study infers that there is a high pelagic and demersal fish diversity and abundance in the west coast of Sri Lanka. Since this is a preliminary study, comprehensive studies on the spatial and temporal variation of abundance and diversity of ichthyoplankton in Sri Lankan waters are recommended.

Keywords: Ichthyoplankton, Fish larvae, Fish eggs, West coast, Sri Lanka

Some Aspects of the Reproductive Biology of *Dasyatis zugei* (Pale-edged stingray) in the Gulf of Mannar, Sri Lanka

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Dasyatis zugei is one of the major non-target species caught in the bottom-set crab nets used for catching blue swimming crab (*Portunus pelagicus*) in Gulf of Mannar. This study aims to determine the length–weight relationship, size at first maturity and fecundity of *D.* zugei. In total of 1,404 individuals were collected from crab nets in two landing sites; Vankalai and Thalvupadu in Gulf of Mannar during the period of September - November, 2018. Disc Width-W_D of all the individuals were measured to the nearest mm, body weight was weighed to the nearest gram and sex was determined. The state of maturity of gonads of females was identified through dissection and macroscopic examination of ovaries. Mean ova diameter significantly varied among females according to the different maturity stages ($P<0.05$). Sex ratio in the catch was 1:1.35 (M: F). Disc width of males ranged from 85-260 mm with a mean of 175.43±22.42 and females ranged from 110-220 mm with a mean of 167.27±17.55. The Disc width-weight relationship was analyzed by Simple Linear Regression using log transformed data and it showed Log W = -0.5923 + 2.364 log W_D for male and Log W = -3.497 + 2.599 log W_D for female. The results show negative allometric growth ($b<3$) for *D. zugei*. There was no significant statistical difference ($P>0.05$) in the male and female regression co-efficient. The size at first maturity was 166.5 mm for female *D. zugei*. Embryos were found only in females ≥ 160 mm of W_D. The maximum fecundity was three embryos per female which is varied with the size of the female. This study reports the first findings on length- weight relationship and size at maturity of *D. zugei* in Sri Lankan waters.

Keywords: *Dasyatis zugei*, Size at maturity, Fecundity, Length-weight relationship, Non-target species

Extraction of Protein from Discarded Shellfish Waste; Value Added Shrimp By-products for fish Feeds

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Shrimp head and shell waste is a rich protein source having the possibility to use in fish feed formulation. Extraction of these valuable proteins from shrimp waste is restricted due to strong covalent bonds ß (1-4) found in chitin-protein. Present study aimed to extract the proteins in high percentages by breaking the chitino-protein bonds in shrimp shells, combining the activity of proteolytic endoenzymes in crab shell waste and temperature activated autolysis. Two tests were conducted. Test I-pressure cooked ground shrimp waste was mixed with ground crab waste at crab: shrimp ratios of 0:1, 1:1, 1:2, 1:3, 1:4 and, 1:9. Tests II: using the same crab: shrimp ratios in Test I without pressure cooking. All the samples in triplicates were heated with continuous stirring at 55 ^{0}C for 15 minutes. Each hydrolysate was dried at 60 ^{0}C and weighed. Crude protein percentage was determined by Kjeldhal Analysis. Data were analysed by one-way ANOVA using SPSS 17 version. No significant difference in crude protein percentage ($p > 0.05$) between pressure cooked and uncooked samples with the same ingredient ratios. Highest crude protein content was recorded in crab: shrimp 1:2 (69.00 ± 12.66%) in cooked samples and in 1:9 (68.66 ± 9.45%) of uncooked samples. In contrast crab: shrimp ratio of 1:9 of cooked samples had comparatively low protein percentage (55.00 ±7.54%). Lowest crude protein percentage recorded in crab: shrimp 0:1 in both uncooked (41.56 ± 5.56%) and cooked samples (42.00 ± 23.38%) as there is no crab wastes are added. Present study reveals that incorporation of crab shell wastes to uncooked shrimp waste and temperature induced autolysis is an efficient method to extract higher amount of protein from shellfish wastes.

Keywords: Shellfish waste, Enzymatic hydrolysis, Temperature autolysis, Protein extract

A Review on Export Trade of Freshwater Ornamental Fish Species in Sri Lanka

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Freshwater Ornamental Fish industry of Sri Lanka has developed rapidly during the last few decades due to high export demand. Industry sustains with culture of exotic species rather than a wild collection of ornamental fish including endemics. Hence, a review on the present status of the export industry of Freshwater Ornamental Fish and identification of the existing gaps are important for further development in the industry. Secondary information on exporting levels, species and countries were collected from Sri Lanka Customs. Further, 32 registered exporters were identified using NAQDA registry and pretested questionnaire was used to collect information on knowledge of exporters, productivity and export details. Results revealed that majority of export fish varieties were Guppy (87%) followed by Platy (3.3%), Molly (2.2%), Tetra (2%), Zebrafish (1.7%) and Barb (0.9%). According to the results, demand for the exporting fish is changed with the quarters of the year and majority of the species (Guppy, Platy, Molly, Tetra) have high demand in 1st quarter. Demand for Zebra fish and Barb fish has high demand in 4th and 2nd quarter of the year respectively. Results of the survey indicated that 80% of companies target only the export market rather than local trade. Majority (55%) of the exporters depended on local farmers to fulfill their requirement of export market. This vast export demand still cannot be achieved due to the communication barriers (67%) among farmers and exporters. The major constrains were identified as difficulties of recognise the actual market demand (87%), lack of adequate knowledge and technical approach regarding disease control (73%) and water quality management (87%). "Ceylon Fish Guide" a user-friendly android tool was developed to enhance the knowledge and communication of farmers and exporters. Therefore, improving the ornamental fish industry with novel technologies is important to compete with global market.

Keywords: Freshwater ornamental fish, Sri Lanka custom, Exporters, Mobile application, Lanka Fish

Effect of Nitrogen Sources on Growth Performance of Marine Microalgae *Nannochloropsis sp.*

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Nannochloropsis sp. is a marine micro alga immensely valuable for aquaculture and food industry as they are rich sources of essential fatty acids, pigments, amino acids and vitamins. Present study was conducted to identify the effect of nitrogen sources on their growth and nutrient content in the cells. For the study, F/2 culture media was used as media in control culture which contains $NaNO_3$ as the source of nitrogen. The F/2 culture media was prepared by using KNO_3 (9 g l^{-1}), CH_4N_2O (Urea) (27 g l^{-1}) and NH_4Cl (47.3 g l^{-1}) as the sources of nitrogen in the culture media. Algae cultures were prepared in triplicates for all treatments and cultivated under indoor condition, maintaining the 27 ºC of constant temperature and 25ppt of salinity with a continuous aeration. The results of ten days culture revealed that there was no significant difference for cell density with the time for all treatments (Two-way ANOVA: $p>0.05$). However, significant difference was found for chlorophyll-a nitrate and nitrite content which are produced by *Nannochloropsis sp*. ($p<0.05$). The significantly highest chlorophyll-a, nitrate and nitrite content were reported in the F/2 culture media with urea than that of other culture media treated with potassium nitrate and ammonium chloride. The Urea can be recommended as a more effective source of nitrogen for F/2 culture media to obtain high chlorophyll-a, nitrate and nitrite content for *Nannochloropsis* sp. culture. This study provides baseline information about the appropriate nitrogen sources which can elevate the higher productivity of *Nannochloropsis sp.*

Keywords: Nannochloropsis sp, Nitrogen sources, Nitrogen content, Cell density, Marine micro algae

Preliminary Investigation on Current Status of Freshwater Fishery Sector and Sensory Qualities of Selected Food Fish in Three Selected Reservoirs of Badulla District in Uva Province of Sri Lanka

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Sri Lanka is rich with large number of reservoirs which are highly useful for irrigational activities and inland fisheries. In Uva province, there is a high potential in expansion of freshwater fish production in reservoirs. Current status of inland fishery sector needs to be evaluated, prior to implement appropriate fishery management measures Also, assessment of organoleptic properties of food fish are useful to identify consumer acceptance for freshwater fish varieties. This study focused on 02 objectives: investigation of present situation of inland fishery sector and identification of organoleptic aspects of major fishery resources in 3 selected reservoirs of Badulla District. Sorabora, Ulhitiya, Rathkinda reservoirs were selected for the study considering production levels based on secondary data. A survey was conducted using pretested structured questionnaire to collect the data on fish production, harvesting methods, fishing gears, and food fish varieties focusing on 122 fishermen in 3 reservoirs. Food fish sources with highest demand and production were subjected to sensory assessment. Gill net (3.5" mesh) was the prominent fishing gear, while "manna" (kind of harpoon) and "karaka" (cover pot) was used into lesser extent for harvesting fishes. All fishermen used non-mechanized fiberglass canoes (length 15.5ft-18ft) as most common fishing craft during fishing operations. Fish yields in reservoirs were affected by climatic variation. Nile Tilapia: *Oreochromis niloticus* accounts for >80% of total fish production with high demand (80%) in 3 reservoirs. Thus, sensory assessment was conducted for Nile Tilapia samples only. Mozambique Tilapia: *Oreochromis mossambicus,* Malkorali: *Etroplus suratensis,* Catla*: Catla catla,* Rohu: *Labeo rohita,* Mrigal: *Cirrhinus mrigala* and freshwater prawn: *Macrobachium rosenbergii* were minor contributors to the total harvest. Based on sensory evaluation, Nile Tilapia samples from Sorabora reservoir recorded highest consumer acceptance as complying with survey results. At present, more than 60% of fishing community in 3 reservoirs has not engaged with processing of value added products. Current study revealed the organoleptic aspects of Nile Tilapia flesh and data on freshwater fishery is useful as baseline information in fishery management programmes of Uva province.

Keywords: Inland fishery, Tilapia fish, Seasonal and perennial reservoirs, Freshwater fish production

Evaluation of Sensory Qualities of Catla Fish (*Catla Catla*) in Three Selected Reservoirs of Badulla District, Uva Province, Sri Lanka

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Catla (*Catla catla*) is one of the common exotic Indian carp species in inland fishery sector of Uva province in Sri Lanka. There is a high potential to develop Catla fish production and introduce value added products from the excess fish harvest. Environmental factors can significantly affect the physico-chemical and organoleptic quality of fish meat. Current study was focused on investigating Organoleptic properties of Catla fish flesh from 03 reservoirs selected (Ulhitiya, Rathkinda, Sorabora reservoir) with higher fish production in Badulla district. The fish samples with weight of 6.0 -12.5 kg and length of 65cm-95 cm were collected from the landing sites of three selected reservoirs. Prepared fish fillets were subjected to steam cooking for 10 minutes without adding spices at temperature of 100^0C. The sensory evaluation was conducted using 05-point hedonic scale to assess the sensory characters; color, texture, aroma, mouth feel, taste, overall acceptance of the steamed fish fillets by 30 untrained panelists. Sensory scores were statistically assessed through Friedman non parametric test. As results revealed, all the sensory parameters of flesh samples are significantly different according to the type of reservoir ($p<0.05$). Highest estimated median for all the organoleptic parameters (color/texture/aroma/mouth feel/taste=4, overall acceptance=5) were recorded for Catla flesh samples of Ulhitiya reservoir showing that, Catla fish from Ulhitiya reservoir has highest consumer preference. Sensory qualities of fish flesh depend on different kind of factors such as characteristics of living environment, fertility of water, availability of food and climatic condition. In conclusion, consumer acceptability also depends on organoleptic properties of fish samples. Detailed study on biochemical and physical quality changes of Catla fish samples in different reservoirs is recommended improve knowledge on fish quality.

Keywords: Carp fish varieties, Sensory parameters, Consumer acceptability, Environmental factors, Inland fishery

Social Relationships of Dried Fish Producers in Trincomalee District, Sri Lanka

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Being a traditional source of animal protein in local diet, dried fish accounts for 4% in Sri Lankan average monthly household expenditure. Although, 70% of local dried fish products come from North & East Provinces, a production oriented dried fish studies are lacking. This study aims to investigate producer based intra & inter relationships & social & cultural influences on dried fish production. A mixed method approach was adapted to glean data from Kinniya & Muthur in Trincomalee District in Eastern Sri Lanka. A questionnaire survey (n=60) & in-depth interviews (n=10) were conducted to gather quantitative & qualitative data respectively. The snowball sampling method was employed. Gathered data were analyzed descriptively. Findings unravel multiple intra & inter relationships of dried fish producers particularly on knowledge sharing, fresh fish supply, supporters & buyers. Awareness on dried fish processing descends from parents (53%). Fresh fish sources are; boat owners (35%), fishermen (31%) & fish traders (25%). Intra relationships are prominent among supporters such as family & siblings (44%), friends (21%) & relatives (16%). Almost all producers (100%) sell through wholesaler demonstrating an external relationship with outsiders. Albeit, there are multi-faceted intra & inter relationships, an institutional arrangement is lacking. Muslims culture in both sites allows only men to engage in dried fish processing minimizing women involvement. Social & cultural analysis indicated that intra & inter relationships are converged toward family, siblings & relatives representing inner most tier of the community. Religion & cultural taboos further restrict expansion of the industry. Establishment of dried fish producers, association would be worthwhile by giving equal opportunities for both men & women producers that broaden their social networks & relationships to expand production

Keywords: Dried fish production, Socio analysis

Growth Performance of *Holothuria scabra* (Sand Fish) with Different Stocking Density in Open Sea Pen Culture in Jaffna, Sri Lanka

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Sea cucumber, *Holothuria scabra* is over exploited species in worldwide due to the high fishing intensity from the wild stocks. Sea cucumber pen culture practices are being expanded in Northern Province of Sri Lanka and presently operated more than 57 pen culture farms in the region. This research is intended to investigate the growth performance of *H. scabra* pen culture with different stocking densities to find out the most appropriate stocking density to introduce the farmers. This research was carried out in coast of Mankumpan village in Jaffna district, Sri Lanka. Early matured *H. Scabra* with average weight 49.78 g and average length 11.28 cm were collected from the Sea cucumber farmers. Four pens were constructed by using 5 mm mesh size high density polyethylene nets and wooden planks. The size of each pen was 25 m^2. Early matured *H. scabra* was reared with stocking densities of 1, 2, 3 and 4 individual m^2. Thirty percentage sample size was randomly collected in each pens to measure the growth parameter. Average length, weight and water quality parameters were measured twice a month and finally, survival rate was calculated. After 60 days of the culture period average specific growth rates were calculated twice a month and it shows 2.53 ± 0.56 $gday^{-1}$, 1.98 ± 0.20 $gday^{-1}$, 1.95 ± 0.21 $gday^{-1}$ and 1.08 ± 0.27 $gday^{-1}$ for pen 1, pen 2, pen 3 and pen 4 respectively. Data was analyzed using Minitab17 version by one-way ANOVA test. Average survival rates for pen 1 and pen 2 were recorded as 100% and for pen 3 and pen 4 were recorded as 85.33% and 85% respectively. Temperature, Salinity, P^H, Nitrate and Phosphate were ranged 27−31^oC, 35−40 ppt, 7.3−8.8, 0.25−2.5 mgL^{-1} and 0.38−0.44 mgL^{-1} respectively. The results show that, there were significant difference ($p > 0.05$) between Specific growth rate and stocking density. The result indicated that the specific growth rate and survival rate were higher in pen 1 and pen 2 than pen 3 and pen 4 and applicable for the implementation.

Keywords: Holothuria scabra, Pen culture, Growth performance, Stocking density

A Comparative Study on Ancient and Contemporary Fisheries Management Systems in Inland Reservoirs of Anuradhapura District in Sri Lanka: A Review

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Archaeological evidences prove that fishery activities were initiated during pre-historic era. According to historical evidences, inland fishery was one of the important economic activities in ancient Sri Lanka and it was regularized after introduction of freshwater fish species during British period. This study was focused on investigation of ancient and contemporary fisheries management systems under four criteria such as, decision making, fishing gears, fish varieties, fish selling and revenue process in Anuradhapura District. 220 fishermen were selected using stratified sampling and data were collected using self-administrated questionnaire, interviews with key persons and group discussions with fishermen. Secondary information was collected from National Aquaculture Development Authority (NAQDA), Department of Fisheries and Aquatic Resources and library survey. Results of the present study revealed that current fishery practices were managed through community based organizations, NAQDA officers and strong legal framework. As recorded in literature, ancient inland fishery activities were managed by *Welwidane* with the support of set of norms. In ancient time *karaka*, *Kemana, Iratiya*, *Athnagu* were used as fishing gears to catch native fishes such as *Heteropneustes* sp, *Anabas* sp, *Channa* sp, *Wallago* sp. At present, pole & line and gill nets were used as legally accepted gears to catch exotic food fishes such as Indian/ Chinese carps and Tilapia. Mainly barter system was applied during the ancient period and *Machchabaga* & *Diyabeduma* taxes were applied for harvest & usage of tank. Currently, organized fish selling system is practicing at landing sites and in well managed fishery systems, toll collection was observed. However, no direct taxes were applied in contemporary systems. Both pros and cons were identified in two systems. Abiding nature of villagers, dissemination of harvest and community services practiced can be taken as positive examples from ancient system.

Keywords: Native fish, Fisheries history, Fishery practices, Fisheries management

Ackonowledge Uva Wellassa University grant, UWU/RG/2018/030

Biodiversity & Conservation

- Sustainable Use of Biodiversity
- Balancing Biodiversity Conservation with Community Livelihoods
- Threats On Biodiversity
- Ecosystem Functions and Services
- Eco-Restoration and Biodiversity Conservation
- Conservation of Biodiversity in Different Ecosystems
- Microbial Resource Bio-Diversity
- Aquatic Biodiversity and Its Conservation and Management
- Population, Land Use and Biodiversity
- Ecotourism and Conservation of Hotspots
- Any Other Relevant Topic Relating To The Main Theme

Efficient Microorganisms for Bioethanol Production from the Natural Environment of Sri Lanka

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Sri Lanka is biologically diverse. The potential of utilizing this rich biodiversity for sustainable socio-economic development of the country is extensive. The vast microbial diversity is a key component in biological diversity. However, the industrial scale application of native microorganisms is still underutilized. The objective of this study was to explore microbial flora of Sri Lanka to isolate efficient cellulolytic fungi and ethanologenic yeast for application in bioethanol production. Fifty fungi were isolated from soil. The total cellulase activity of fungal isolates was determined to compare cellulase production. Yeasts were isolated from local fruits *viz:* grapes, oranges and mangoes. Ethanol production by each yeast isolate was assessed in a glucose containing fermentation medium. Detection and quantification of ethanol were done by High Performance Liquid Chromatography (HPLC) using ethanol standards. The HPLC analysis was conducted using Milli-Q water in 0.6 ml/minute flow rate as the solvent. Hi-Plex H, 300×7.7 mm column was used with Refractive Index Detector for ethanol detection. Both were maintained at 55 ˚C temperature for the analysis. According to the results, the highest total cellulase activities were given by fungal genera *Trichoderma*, *Aspergillus* and *Penicillium. Trichoderma viridae* was the most efficient isolate giving a total cellulase activity of 0.574 FPU/ml followed by the *Aspergillus niger*, being the second most efficient cellulase producer with 0.464 FPU/ml total cellulase activity. Total cellulase activity of *Penicillium oxallicum* was, 0.438 FPU/ml, which was not significantly different from *A. niger.* Among six ethanologenic yeast, the highest ethanol concentration was given by Y3 isolate as 9.651% while Y5 showed 5.84 %. All the isolates reported ethanol yields above 2%. There is a great potential of applying these efficient isolates in bioethanol production because cellulolytic fungi can degrade cellulose to release fermentable sugars for yeast.

Keywords: Cellulolytic fungi, Cellulase activity, Ethanologenic yeast

Morphological Characterization and Distribution of *Lagenandra praetermissa* de Wit & Nicolson

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Lagenandra praetermissa is an aquatic endemic species distributed throughout the Wet and Intermediate zones along the rivers, streams and marshy habitats. According to National Red List 2012 the plant is listed under the "Least Concern" category. The recent field observations indicated a reduction in subpopulations and variations in vegetative morphology. Hence the present study was focused on distribution and morphological diversity of *L. praetermissa* which would contribute to its conservation. Field collections were made covering Wet, Dry and the Intermediate zones of the country. At least three plants were studied in detail from each population for coding morphological characters. Twenty-three qualitative and quantitative vegetative characters of individuals from 34 different subpopulations were coded into a data matrix and a morphometric analysis was carried out using the PAST software. Distribution of the subpopulations were recorded using GPS locations. Further, the soil pH and threats were also recorded for each location. Although *L. praetermissa* was recorded as occurring in the Kandy and Kalutara districts during the revision of the family in 1986, according to the present study they were also recorded from Badulla, Kegalle, Kurunegala, Matara, Rathnapura and Monaragala districts which extends its distribution to the dry zone. Even they exhibit a wider distribution, most of these subpopulations occur outside protected areas in polluted disturbed streams and river banks. The soil pH ranged from 4.7-6.3 which is acidic indicating the polluted nature of the habitats. The cluster analysis identified two phonetic groups, separating at a 32 distance units, while these two groups further divided into sub-clusters. The petiole length and the leaf laminar length were the most contributing characters. The identification of two different phenetic groups of *L. praetermissa* indicates its morphological diversity which needs to be further studied using molecular data to identify whether these belong to distinct groups.

Keywords: Araceae, Conservation, Endemic aquatics, morphometric analysis

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Species Limits in *Curvularia*: Updated Backbone Phylogeny and Fresh Collections from Sri Lanka

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The genus *Curvularia* comprises of fungal species frequently encountered as saprophytes, endophytes and pathogens. Both living and dead weeds as well as crops are well known for the survival and completion of life cycles of *Curvularia* in nature. Molecular phylogenetic assessments are leading to precise identification of species in this genus from closely related taxa since morphological identification alone is often insufficient for species discrimination. Updated molecular phylogeny with all the existing *Curvularia* species is essential in order to infer phylogenetic relationships for freshly collected strains. The major objective of this study is to assess the evolutionary relationships of species of *Curvularia* collected from Poaceous crops and related weed hosts in Sri Lanka incorporating them in an updated backbone phylogeny with all of the available ex-type *Curvularia* sequences. Fresh collections were made from selected Poaceous weeds, rice and maize crops and morphological characters were assessed based on microscopic imaging and culture based studies. An updated backbone phylogenetic tree was constructed based on ribosomal Internal Transcribed Spacer region and partial Glyceraldehyde 3-Phosphate Dehydrogenase using maximum parsimony, was used to place the fresh collections within the genus. In addition, Phylogenetic Informativeness (PI) profiling test was performed to evaluate the informativeness of loci at species level phylogenetic discrimination. The PI profiling proved that the GPDH is the highest informative locus among the loci compared for this genus. The fresh collections of *Curvularia* from local study sites which were incorporated in the current phylogeny were grouped within several different clades such as *geniculata*-clade, *hominis*-clade and *lunata*-clade, emphasizing the existence of diverse array of species among fresh collections. Therefore, it is vital to collect more samples from both crops and weed residues in order to establish impact on these pathogens on crops and to understand their host range and shifting patterns of life modes.

Keywords: Fungi, Pathogen, Phylogenetic informativenes, *Curvularia* spp.

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Monitoring Tributyltin (TBT) Contamination of Southern Coastal Waters in Sri Lanka

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Tributyltin (TBT) is an organotin compound belongs to the group of Persistent Organic Pollutants (POPs) and one of the active ingredient in antifouling paints used for boat hulls, docks, fish nets in order to prevent the growth of aquatic fouling organisms. The presence of TBT in the aquatic environment is extremely toxic to target and non-target organisms and it is responsible for severe sexual disorders like sex changes called imposex leading to sterile aquatic populations which lead to decline of animal diversity. According to WHO, the No Observed Effective Level (NOEL) of TBT is below 1 ngL^{-1}. However, there are no information has been recorded regarding the TBT contamination in water and its adverse effect on aquatic organisms in Sri Lanka. Therefore, the study aims to monitor the contamination status of TBT in southern coastal area in Sri Lanka. Coastal water samples were collected from river canals, fishing harbors and river mouth along the Southern Coastal area from Dehiwala to Mirissa. TBT was extracted by using a newly optimized Solid Phase Micro Extraction (SPME) method. Hydridization process was followed for quantification by using the Gas Chromatography-Mass Spectrometry (GC-MS) in parts per trillion level (ppt). Results showed that the highest TBT concentration in highly polluted Dehiwala ($3.4ngL^{-1}$) and Wellawatta canals ($3.4ngL^{-1}$). TBT concentrations in fishing harbors at Ambalangoda, Galle, Mirissa and Beruwala were range from 1.4 ngL^{-1} to $3.2ngL^{-1}$ where in Madu and Benthota river mouth were $0.8ngL^{-1}$ and $0.9ngL^{-1}$ respectively. The recovery of the TBT extraction method was 87±0.1% for the artificial sea water. Thus, the preliminary results of the study showed that high contamination of TBT may adversely effect on marine biodiversity.

Keywords: Tributyltin hydride, Imposex, Solid Phase Micro Extraction (SPME), Gas Chromatography- Mass Spectrometry (GC-MS).

Composition of the Faunal Community Fouling On Long-Term Test Panels Deployed in Colombo Port, Sri Lanka.

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Studies in biofouling on artificial substrates have been carried out globally in order to understand the community succession, mechanisms, associated invasive species as well as addressing the issues. However, in Sri Lanka, such information is very much lacking and present study is to address such knowledge gap. The study was conducted in Colombo port in four sampling locations from February 2016 to March 2017 using experimental panels. Entire set up was pulled out of the water and photographed alive during monthly sampling cycle before placing them back in the water. Species identification was done to the lowest possible taxonomic level using live photographs which were taken in the field. In the laboratory, the photographs were analyzed to determine percentage cover using Photoquad software. From the succession analysis of permanent settlement collectors, 74 different fouling organisms were recorded belonging to 8 different taxa including Bryozoans (8 species), Annelids (12 species), lower Chordates (23 species), Molluscs (13 species), Arthropods (7 species), Poriferans (5 species), Cnidarians (5 species) and Echinoderms (1 species). Among the species recorded, eleven were globally known invasive species. Furthermore, the Dendrogram derived from cluster analysis showed a close relationship among members of the fouling community. Especially among the native bryozoan *Arbopercula bengalensis* and tube worms (Sabellidae); whereas one cryptogenic (*Celleporaria volsella*) and two native (*Parasmittina parsevalii* and *Hippoporina indica*) bryozoan species also shared a close relationship among each other. Moreover, arthropods and tunicates also showed a close relationship. However, two major nonindigenous species, *Schizporella errata* and *Mycale* sp. showed noticeable deviation, indicating their exceptional solitary behavior despite the presence of other members of the fouling community.

Keywords: Colombo port, Succession, Biofouling, Experimental panels

Screening the Effects of Microplastics on Selected Invertebrates along Southern Coastal Belt in Sri Lanka: A Preliminary Approach to Coastal Pollution Control

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Primary and secondary microplastics entering into coastal and marine environment are potentially harmful to the health of aquatic organisms. Current study intended to assess plastic pollution effects on sessile invertebrates along the Southern coastal belt of Sri Lanka during July-December 2018. Twelve sampling sites (Hambantota, Godawaya, Rekawa, Tangalle, Dickwella, Polhena, Mirissa, Weligama, Unawatuna, Gallefort, Dodanduwa and Hikkaduwa) with different anthropogenic activities were selected as representing 03 districts (Hambantota, Matara, Galle) of Southern province. Biodiversity survey was conducted to identify prevalence of natural inhabitants in selected regional coasts and 03 dominant coastal mollusks: *Saccostrea cucullata* (Rock Oyster), *Littorina* sp. (Periwinkle) and *Patella* sp. (Limpets) were selected for screening microplastics accumulation level. Alkaline digestion protocol was identified as the most suitable procedure for microplastics extraction considering plastics recovery rate and digestion efficiency of flesh. Randomly collected, pooled biological samples (N=20-2) were subjected to KOH digestion and resultant microplastics were verified using hot needle test. As results revealed, all 03 invertebrates were contaminated with microplastics accumulation at average rates of 7.2-2.8counts/g in all sampling sites. Majority of contaminated microplastics were filamentous types (>90%) followed by rod shapes (1%). Microplastic accumulation rate varied significantly according to the type of species ($p<0.05$) due to differences of their feeding mechanism. Further, filter feeding organisms (Rock Oysters) were highly susceptible in accumulation of microplastics (7.2-4.1counts/g) in their bodies, while plastic accumulation rate was highest in oysters from Hambantota. Microplastic accumulation rate of mollusks was not significantly different according to the sampling site due to closer proximity ($p>0.05$). Tourism, unsustainable coastal fishery and harbor operational activities were identified as key factors affecting on higher plastic pollution level on Southern coast. Current study reflects negative aspect of plastic pollution on intertidal organisms.

Keywords: Anthropogenic activities, Plastic pollution, Microplastics accumulation rate, Intertidal zone, Bio-indicator organisms

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Zooplankton Studies in East Coast of Sri Lanka

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Zooplankton plays a vital role in marine environment by transferring the energy to higher trophic levels through the food web. However, the studies on zooplankton in the coastal water of Sri Lanka especially in the East coast are deficient. The present study was conducted to investigate zooplankton abundance in East coast of Sri Lanka in marine resources survey using the Research Vessel: Dr. Fridtjof Nansen during June to July 2018. Twenty-five samples were obtained from five transects using WP2 plankton net with 180µm mesh size. The samples were collected vertically from 30 m, 100 m and 200 m depths. In the laboratory; zooplankton was identified to the lowest possible taxonomic groups using standard keys and counted. The results revealed that zooplankton are dominated by the Phylum Arthropoda (63%), followed by Chordata (20.6%), Sarcomastigophora (7.4%), Chaetohnatha (4%), Cnidaria (2.5%), Annelida (1%), Echinodermata (0.4%), Mollusca (0.4%) and Ciliophora (0.2%). The highest (13053.57 m^{-3}) and lowest (5747.43 m^{-3}) abundance were recorded at transects near Mullaitivu and Batticaloa respectively. The study showed that there was no significant difference ($p>0.05$) of the abundance of zooplankton among the sampling stations. However, abundance of the zooplankton between shallow and offshore sampling stations were significantly different ($p <0.05$). The abundance of zooplankton at the depth of 100 m indicated an increasing trend towards Batticaloa. Offshore (100 m and 200 m) zooplankton abundance (2697 m^{-3}) at 30 m depth was higher than the abundance of nearshore samples (1298 m^{-3}). This study revealed that there are spatial variations of zooplankton in East coast of Sri Lanka and it may affect the fish production in the area. Therefore, further comprehensive studies on zooplankton are recommended to find out the possible reasons for such variations which could be useful in managing the marine environment.

Keywords: Zooplankton, East coast, Abundance

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Assessment of Suspended Plastic Levels in Surface Water of Southern Coastal Belt in Sri Lanka

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Plastic pollution is a growing concern all over the world including Sri Lanka due to serious negative consequences. Thus, current study focused on investigation of occurrence, quantification and spatial distribution of visually observed plastics and microplastics (MPs) in surface coastal water from 12 locations (Hikkaduwa, Gallefort, Dodanduwa, Unawatuna, Weligama, Mirissa, Dickwella, Tangalle, Polhena, Rekawa, Godawaya, Hambantota) as covering 3 districts of southern coastal zone in Sri Lanka during July-December 2018. Surface water samples were collected by towing neuston, manta net (380 µm) along surface layer parallel to the shoreline using repeated measures approach. The samples were passed through 4000 µm, 500 µm and 250 µm mesh sieves and residual MPs were subjected to Wet Peroxide Oxidation protocol. Visually observed plastics and recovered MPs were observed through Trinocular Microscope, enumerated for density and confirmed by hot needle test. MPs were further sorted according to the color and shape. As results revealed, all the coastal water in sampling sites were contaminated with plastic accumulation. Overall average density of macroplastics and mesoplastics were recorded as 3.32 and 3.37 items/m³. Sampling location had no significant effect ($p>0.05$) on total MPs density (average total MPs density: 18.06±11.45 items/m³). Plastic accumulation sources of the affected sites were identified as harbor operational activities, residential actions and recreational events. MP debris with 0.51-2.00 mm consists of >65% of total number of MPs, whereas maximum size of microscopic plastic in coastal water was 11.04 mm. Fibers were the most common MPs followed by films. Blue colored and Transparent MPs were the majority of plastic items in coastal water due to prevalence of above plastic categories used in the packaging, bottles and fishing gears. In summary, southern coastal water in Sri Lanka is polluted by plastic debris and pollution control programmes are recommended by this study.

Keywords: Microplastic density, Water pollution level, Coastal pollution control, Anthropogenic activity

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Present Status of Export Trade of Endemic and Indigenous Freshwater Ornamental Fish Species in Sri Lanka

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Sri Lankan ornamental fish export industry has developed rapidly during last decade due to high demand. Recent surveys have indicated that wild collection of endemic and indigenous freshwater ornamental fish species has caused serious conservational issues. This study aims to evaluate the present status of export trade of endemic and indigenous fish species in Sri Lanka during 2016-2017. Secondary information on type of freshwater fish species which were exported as ornamental fishes and their levels of exporting were collected from Sri Lanka Customs. Pre-tested questionnaire was used to collect data from 15 ornamental fish exporters, including the details of restricted and prohibited species and current status of the export industry. Results of the study indicated that the exportation of endemic species and indigenous species have been reduced by 43.7% and 9.4% respectively in 2017 when compared to 2016. Highest export trend were recorded on *Garra ceylonensis*: endemic fish species (48.7%) and *Monodactylus argenteus*: indigenous species (69.6%). Only 20 species of restricted freshwater fish have exported in 2016 and not reported at 2017. The major export destinations of Sri Lankan endemic and indigenous fish was USA (22%) followed by Netherlands (18%) and Australia (10%). The results of the questionnaire survey indicated that a limited number of exporters (40%) tend to export endemic fish species due to legal barriers. Further, captive breeding of Sri Lankan endemic fish varieties (*Puntius titteya*) outside the island may threat to the ornamental fish trade of Sri Lanka. A high proportion of exporters (80%) are over depended on the wild collection which leads to overexploitation of demanded species. Further, natural habitats of the wild population are negatively affected by deforestation and environmental pollution. Therefore, improving the captive breeding for wild catch species is important to ensure the sustainability of ornamental fish trade.

Keywords: Freshwater ornamental fish, Endemic fish, Indigenous fish, Export trade, Overexploitation

A Preliminary Study of the Faunal Diversity in a Fragmented Lowland Evergreen Rain Forest Patch: Wawekele Reserve Forest, Avissawella, Sri Lanka

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The abundance of lowland evergreen forest patches within the lowland wet zone is considerably very high in Sri Lanka and they function as invaluable natural production systems through providing catchment areas for regional water sources like rivers, streams, wells etc. A preliminary study was conducted to assess the faunal diversity in the Wawekele Reserve forest area in the Southern boundary of Colombo District in Sri Lanka. This forest covers 45 ha and falls within the lowland wet zone, at an elevation of 90m-120m above sea level. Approximately, 600 person hours were spent in the field over a period of six years from August 2012 to August 2018 to document freshwater fish, amphibians, reptiles, birds, mammals, butterflies and dragonflies through the visual observations following the trails and streams within day time. A total of 131 different faunal species including 08 freshwater fish species, 05 amphibian species, 15 reptile species, 64 bird species, 05 mammal species, 22 butterfly species and 12 dragonfly species were recorded from Wawekele, of which 03 freshwater fish species (37.50%), 05 amphibian species (~100%), 04 reptile species (~26.67%), 06 bird species (~9.38%), 02 mammal species (~40%), 02 butterfly species (~9%) and 02 dragonfly species (~16.67%) are endemic to Sri Lanka. Out of 131 species recorded 10 (7.63%) Near Threatened, 04 (3.05%) Vulnerable, 05 (3.82%) Endangered and 01 Data deficient (0.76%) species according to the red list of 2012 by international union for conservation of nature. This lowland evergreen forest patch is affected by noise pollution due to its locality near an urban area. Further night time observations are required to uncover the nocturnal faunal species and more detailed studies are required to formulate the better management plans for conserve this bio diversity rich forest patch.

Keywords: Bio diversity, Catchment area, Conservation, Lowland wet zone, Wawekele reserve forest,

Is the Future of Mangroves in Vidattaltivu Nature Reserve Secured? A Community Based Study

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Vidattaltivu is a coastal region and composed of four adjacent grama-niladhari divisions with a close knit community of about 600 families. It is located in Manthai West divisional secretariat division of Mannar District, Northern Province, Sri Lanka. Vidattaltivu has been declared as Vidattaltivu nature reserve since 2016, because of its luxurious but highly vulnerable mangrove ecosystem. Regardless, the mangrove vegetation in Vidattaltivu is still at a great risk mainly due to destruction and illegal felling of mangroves, pollution and inadequacy of management and conservation interventions. This study was aimed at understanding the community's awareness, knowledge and perception on mangroves in Vidattaltivu and emphasizing the importance of the community involvement and participation in order to protect this valuable ecosystem for future. Questionnaire survey method was employed and a pre-tested questionnaire was distributed among 100 respondents in Vidattaltivu. The findings suggest that majority of respondents (77.86%) are having a higher degree of knowledge and awareness on mangroves but are not willing (89.00%) to take the prime responsibility to protect the ecosystem. This type of negative behavior of locals is typically encouraged by neglecting of sociological & socioeconomic factors and ignoring of suggestions & needs of local communities in planning and implementation stages of protected area management. Apart from that, the exclusion of ownership of the mangroves from local communities might have lessened their commitment towards conservation of this ecosystem. Nevertheless, the respondents showed a higher level of readiness and capacity (86.25%) towards community participation in mangrove management, which can be utilized productively in future if they are encouraged and empowered properly.

Keywords: Mangroves, Vidattaltivu, Conservation, Community participation

Biofouling Community Composition Along the Coast Adjacent to Colombo Port

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Sri Lanka is located in close proximity to the east-west maritime route with an increased risk of invasion by Non Indigenous Species (NIS) in the coastal waters. Here, Colombo port is one of the top risked ports in terms of potential NIS introductions and the presence of many introduced species remained mysterious until extensive work on biofouling community was initiated in 2014 by the authors. However, knowledge on fouling composition along the adjacent coast around the port is also scarce. Therefore, an extensive survey was conducted along the coast adjacent to the Colombo port to determine the presence and extent of dispersion of NIS. The survey was conducted during the months of May and June, 2018 in both north (Colombo port to Negombo) and south side of the Colombo port (Colombo port to Panadura). Samples were collected using belt transect (10m x 3m) covering both high tide and low tide in the selected sampling locations. Fouling organisms adhere to rocks, piers and floating objects were collected. Organisms which were already identified were recorded at the site itself and new species and any species had doubt on identification, were photographed and transported to the laboratory for further analysis. 42 species of fouling organisms were identified belonging to 7 taxonomic groups as Bryozoa (4 species), Annelida (5 species), Chordata (7 species), Mollusca (8 species), Arthropoda (10 species), Porifera (6 species), and Cnidaria (2 species). Eleven species were common to both side and altogether 24 species were found to be mutual to Colombo port and adjacent coast. Six NIS were recorded which were also observed in Colombo port revealing the presence of NIS in adjacent coast. Therefore, present findings alarm the impending risk of spreading NIS introduced to Colombo port and immediate attention must be taken to manage the existing NIS community in Colombo port as well as continuous monitoring is recommended for possible early detection of future NIS spreading.

Keywords: Colombo port, Adjacent coast, Biofouling, Belt transact, Survey

Accumulation of Proline in Plants of Mangrove and Maritime Ecosystems in Southern Wet Zone of Sri Lanka

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Mangroves and maritime plants are the only halophytes living at the influence of land and sea, and occupy tropical and subtropical coastline. Mangrove and maritime communities are recognized as part of the marine ecosystem and are highly productive ecosystems. Saline habitats represent a physiological challenge for plants because of the highly negative water potential of the soil water, making water acquisition difficult. Osmotically active solutes such as mannitol, proline, glycinebetaine and triterpenoids are necessary to reduce water potential in cell cytoplasm. The present study was done with the objective of estimating the accumulation of proline in leaves of mangroves, mangrove associates and maritime plants in Southern wet zone of Sri Lanka. Proline concentrations in leaves of 12 mangroves, 5 mangrove associates and 15 maritime plants were measured by following the standard procedures with using UV/VIS spectrophotometer at 520 nm wave length. Further, proline concentrations were estimated in maritime plants of varying distances from the sea after plants were selected along the line transects of 200 m from the sea coast. Proline was accumulated in all tested mangrove, mangrove associates and maritime plant leaves with the varying concentrations. Among them significantly higher proline levels are found in the leaves of maritime plants *Terminalia catappa*, *Flemingia strobilifera*, *Scaevola taccada*, mangroves such as *Nypa fruticans*, *Bruguiera gymnorrhiza* and mangrove associate *Anona glabra*. Further, according to Pearson correlation analysis, there was no correlation observed on average proline concentration of maritime plants leaves and changing distances of 200 m from the sea coast ($p= 0.477$). An increment of proline accumulation was evident in majority of plant species of mangroves, mangrove associates and maritime vegetation in Southern wet zone of Sri Lanka under salt stress.

Keywords: Mangroves, Maritime vegetation, Mangrove associates, Proline, Accumulation

Study on Diversity and Abundance of Cetaceans off Mirissa, Southern Coast of Sri Lanka

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Sri Lanka is rich with marine cetaceans (whales, dolphins and porpoises) and mainly whale watching industry has immensely developed in Mirissa, Southern coast of Sri Lanka. But up to date surveys on cetacean populations in Southern marine water is in unsatisfactory level. Hence, a shipboard survey to identify their diversity and abundance was conducted in Southern marine water off Mirissa for 48 days during August - December 2018. 5 baleen whales (suborder *Mysticeti*) and 8 toothed whales (suborder Odontoceti) were recorded during the survey period (13 total species). Blue whale (*Balaenoptera musculus*) was the most common type of baleen whale with 443 sightings in $80^0$10´- $80^0$46´ E ,$05^0$55´- $05^0$17´N and 1 - 3 range was their pod size. In addition to that, 60,4 and 3 sightings of Bryde's Whales (*Balaenoptera edeni*), Fin whales (*Balaenoptera physalus*) and Ormura Whales *(Balaenoptera omurai)* were recorded respectively. Spinner Dolphin (*Stenella longirostris*) was the highest abundant toothed whale type with 2765 sightings. In addition to that, 571 of Bottlenose Dolphin (*Tursiops truncatus)*, 125 of Stripped Dolphin *(Stenella coeruleoalba),* 75 of False Killer Whale (*Pseudorca crassidens)*, 54 of Rissos Dolphin, (*Grampus griseus),* 30 of Pilot whale (*Globicephala macrorhyncus*), 7 of Killer Whale (*Orcinus orca*), 6 of Sperm whale (*Physeter macrocephalus*) and 3 of Humpback Whale (*Megaptera novaeangliae*) were sighted. As per whale watcher's data, Humpback Whales were recorded in Southern coast after 2015. Since the whale watching industry in Southern coast is mainly rely on Blue whale population, they are highly vulnerable group from whale watching, shipping and fishing activities. Results provide important information on the conservation status of cetaceans. Therefore, a powerful management measure is highly needed for the conservation of cetacean populations and the sustainability of whale watching industry.

Keywords: Whale, Dolphin, Mirissa, Sightings

Bioprocess Technology

- Food and /Alcoholic Bioprocess Technology (Cheese, Vinegar, Wine and Beer)
- Environmental Bioprocess Technology (Pollution Control and Bioremediation)
- Biopharmaceutical Technology (Antibiotic, Vaccines)
- Diagnostics, Therapeutic Proteins and /Polysaccharides
- Specialty Products and Industrial Chemicals (Fuels, Chemicals and Fiber from Renewable Sources Enzymes, Bio Pesticides)
- Microbial Biomass Production

Effects of Microbial Fermentation on the Antioxidant Potential of Cassava

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This study investigated the effects of microbial fermentation on the antioxidant potential of MU51 cassava products, developed by changing the fermentation lengths as 48 hours and 72 hours. Steps involved were grating cassava into a mash, collecting the mash into sacks, simultaneous dewatering and fermenting the mash. The fermented wet cakes obtained were further de-watered by oven-drying process to make fermented dry products. Oven-dried raw cassava and two fermented dry products were grated and powder obtained from each sample was extracted in ethanol: water (4:1volume/volume) solvent mixture. Solutions were filtered and the extracts were dried. The antioxidant potential of extracts was assessed using Phosphomolybdenum Reduction assay. Reagent solution containing $(NH_4)_2MoO_4$, Na_3PO_4 and H_2SO_4 was mixed with the extracts. Tubes containing the mixtures were incubated for 60 minutes at 37°C and the absorbance of Phosphomolybdenum complexes were measured at 695 nm, using Ultraviolet/Visible spectrophotometer. Total antioxidant potentials of the extracts were expressed as ascorbic acid equivalents g L^{-1} by reference to the ascorbic acid standard calibration curve. The antioxidant potential of oven-dried raw cassava was (2.30-2.42) $x10^{-4}$ ascorbic acid equivalents g L^{-1}, that of 48 hours fermented dry product was (3.38-3.56) $x10^{-4}$ ascorbic acid equivalents g L^{-1} and it increased to (3.92-4.20) $x10^{-4}$ ascorbic acid equivalents g L^{-1}, for 72 hours fermented dry product. Analysis of variance technique showed that antioxidant potentials were significantly different ($p<0.05$) among samples. Literature survey revealed that the ability of fermentation to improve antioxidant potential is due to the increase in the amounts of phenolic compounds and flavonoids, which are results of microbial hydrolysis reactions. Fermentation induces structural breakdown of plant cell walls, leading to liberation of antioxidant compounds. Fermentation significantly enhances the antioxidant potential of cassava.

*Keywords***:** Fermentation, Cassava, Antioxidant potential, Ascorbic acid.

Using Microbial Fuel Cell to Monitor Volatile Fatty Acids in an Anaerobic Process

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Volatile Fatty Acid concentration is a sensitive parameter which affects the optimization and control of the anaerobic digestion process. The research is focused on developing a reliable and a simplified method than the currently used complex methods to monitor Volatile Fatty Acid concentration in this process. A synthetic Volatile Fatty Acid, Acetic Acid was used to develop a Microbial Fuel Cell. First, a correlation was developed between acid concentration and the voltage generated using 0.1M Acetic Acid sample. Then the same procedure was repeated for 3 different Acetic acid samples to check whether the obtained correlation depends on the initial acid concentration. A correlation of $M= 0.0007V^2 + 0.0074V + 0.0769$ was obtained by using average concentration (M) and average voltage (V) of aforementioned repeated trials. After further analyzing this correlation, it was observed that the correlation between voltage and Volatile Fatty Acid concentration is independent of the initial acid concentration. Therefore, this correlation which was obtained using a synthetic Volatile Fatty Acid can be applied to any natural Volatile Fatty Acid sample, irrespective of its initial concentration.

Keywords: Microbial fuel cell, Volatile fatty acid, Salt bridge

Isolation of Antibacterial Compounds from the Endophytic Fungus *Curvularia lunata*

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Bacteria showing resistance to the existing antibiotics have become a human health crisis in the World. Thus there is an essential need to find novel antibacterial compounds as a solution to this antibiotic resistance issue. Cyperaceae family plants are rich reservoirs of endophytic fungi which are potential synthesizers of antibacterial secondary metabolites. Purification of the antibacterial compound/s from an endophytic fungal strain isolated from *Cyperus iria* was the aim of this study. A crude extract of an endophytic fungal culture which was identified as *Curvularia lunata* showed antibacterial activity against Gram Positive *Staphylococcus aureus* and *Bacillus subtilis*. Therefore, this fungus was grown in 150 Petri dishes using potato dextrose agar, incubated for 21 days, extracted into ethyl acetate and the antibacterial activity of the crude extract was tested against *S. aureus* and *B. cereus* at 400 µg/disc concentration. Purification of the active compounds was carried out using bio assay guided chromatographic methods. The crude extract (420 mg) was first fractionated by solvent-solvent partitioning, using hexane, chloroform, ethyl acetate and water as the solvents. The active chloroform fraction was further purified by Sephadex LH20 size exclusion chromatography using methanol and eluted fractions were combined according to their TLC profiles. The combined fractions (A-E) were tested for antibacterial activity. Fraction C from size exclusion chromatography showed antibacterial activity with 13 and 16 mm inhibition zones against the *S. aureus and B. cereus* respectively, Fraction D showed antibacterial activity with 11 mm inhibition zone against the *B. cereus* at 400 µg/disc. The TLC profiles showed fraction C is close to purity while fraction D consists of many compounds. According to the proton NMR spectrum, the fraction C is an aromatic compound. Further purification of fractions may lead to a potential antibacterial agent.

Keywords: Cyperus iria, *Curvularia lunata,* Antibacterial, Secondary metabolites

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Development of Bioethanol from Water Hyacinth (*Eichhornia crassipes*) Using Cellulose Degrading Microbial Biofilm

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Water hyacinth (*Eichhornia crassipes*), a persistent and invasive weed found in Sri Lanka that creates numerous problems to aquatic ecosystems. However, it is a promising candidate for bioethanol production due to its abundant availability, low cost and high yield. Currently, usage of lignocellulosic biomass is sustainable alternative to support the global demand for fossil fuels. Still, the conversion of cellulosic material to fermentable sugar is a rate-limiting step due to its highly resistant nature. Therefore, this study was focused to evaluate the efficiency of production of bioethanol from water hyacinth using cellulose degrading microbial biofilms. Microorganisms were isolated form soil sample obtained from a coir retting land in Kurunegala district and were inoculated on Carboxy Methyl Cellulose Agar to screen the most effective cellulolytic fungi and bacteria. One fungal (F2) and two bacterial isolates (B1, B3) were selected based on the cellulolytic activity. Biofilms were developed from the selected fungi and bacteria based on the high cellulolytic activity. The efficiency of the cellulolytic activity by the biofilms were evaluated using 3, 5 DNS assay. The selected biofilms were combined with 2 g of acid pre-treated water hyacinth and were kept nine days at room temperature for fermentation. *Saccharomyces cerevisae* served as the control. Bioethanol production was estimated by dichromate method and confirmed by FTIR analysis. Out of selected biofilms, F2B3 biofilm showed significantly higher bioethanol production (62.85 ppm, $P< 0.05$) than *Saccharomyces cerevisae* (59.81 ppm) after nine days' of fermentation. Further, the yield of bioethanol obtained by F2B3 biofilm and *Saccharomyces cerevisae* from water hyacinth were 0.037% and 0.032% respectively. Therefore, there is a prospect to enhance the bioethanol production from water hyacinth using the effective biofilms.

Keywords: Bioethanol, Water hyacinth, Biofilm

Production of Bio Ethanol from Sri Lankan Overripe Fruits Using Batch Fermentation and Optimization of Ethanol Yield

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Bio ethanol produced by bio materials are used in many countries around the world as an alternative to gasoline mainly due to better emission characteristics. Since Sri Lanka imports its whole transportation fuel requirement and also committed to reduce greenhouse gas emission, there is a necessity of searching for alternative freely available and low-cost bio resources to produce bio ethanol. The aim of this research was to study the possibility to produce ethanol from Sri Lankan overripe fruits using batch fermentation and then optimization ethanol yield by kinetic modelling. In this research, ethanol production was carried out by fermentation of three different freely available Sri Lankan overripe fruits. Fermentation was carried out by varying fermentation parameters such as type of fruits (banana, papaya, jackfruit), type of inoculums (*Saccharomyces Cerevisiae (yeast)* and a novel microorganism: *Pseudomonas Mendocina* (PM)), concentration of the substrate (1:1, 1:1.5, 1:2 w/w ratio of fruit and water), pH (4.3, 5.0, 5.7), and temperature (27, 32, 35 ^{o}C). Kinetic modelling was carried out using Monod and modified Gompertz equations. Optimization was carried out by fitting experimental data to the theoretical curves using MATLAB software and then selecting the fermentation process with highest correlation between the theoretical and the experimental curve. The highest correlation was obtained by fermentation banana fruit (embul variety) with PM microorganism, 1:1 w/w concentration at pH value 5 and 35 ^{o}C temperature. The concentration of the produced ethanol was 13% V/V. Monod and modified Gompertz equations were well fitted to the experimental data showing higher regression coefficients respectively 99.81% and 99.37%. Compared to the literature a considerable higher ethanol concentration was obtained by fermentation of banana (embul variety) with the novel microorganism: PM than with *Saccharomyces Cerevisiae.*

Keywords: Bio-ethanol, Fruits, Fermentation, Kinetic modelling, Optimization

Acknowledgement: Financial support from the UWU research grant UWU/RG/2018/037

Screening of Alpha Amylase Inhibitory Activity and Antioxidant Activity of Selected Sri Lankan Medicinal Plants

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Diabetes mellitus (DM) is one of the global health emergencies that characterized by high blood glucose levels. Adding antioxidants to the therapy of DM is intended to reduce complications caused by oxidative stress. In the treatment of diabetes, alpha-amylase inhibitory activity and antioxidant activity are playing a significant role. The medicinal plants grown in Sri Lanka have been proven to retard the absorption of glucose by inhibiting the carbohydrate hydrolyzing enzymes, such as pancreatic amylase. Thus, this study was conducted to investigate alpha amylase inhibitory activity and antioxidant activity of *Vernonia zeylanica* (Pupula), *Leucas zeylanica* (Gatathumba), *Trichosanthes integrifolia* (Dummella) and *Crateva adansonii* (Lunuwarana). Aerial parts of the selected plants were air dried and extracts were obtained using 80% acetone with 20% water. The alpha amylase inhibitory activity was performed using 3,5-dinitrosalicylic acid (DNSA) method and starch iodine method and the antioxidant activity was measured using 2,2-diphenyl-1-picrylhydrazyl radical DPPH assay and ABTS radical cation scavenging assay. In DNSA assay, *Vernonia zeylanica* extraction showed the highest significant mean inhibition (29.8 %, $p < 0.05$) at 1000 mg l^{-1} concentration. Out of all plant extracts, the highest significant mean inhibition (51.25 %, $p < 0.05$) for the starch iodine assay was shown by *Crateva adansonii* at 1000 mg l^{-1} concentration. Extracts from *Vernonia zeylanica* showed the lowest IC_{50} value (less than 10 mg l^{-1})for the DPPH assay of the antioxidant activity compared with the IC_{50} value of the standard (ascorbic acid, 7.24 mg l^{-1}). The best IC_{50} was observed from *Leucas zeylanica* for the ABTS assay with the value of 100.7 mg l^{-1} with respect to ascorbic acid (4.75 mg l^{-1}). It was identified that out of all selected plants, *Vernonia zeylanica* possess both alpha amylase inhibitory activity and antioxidant activity.

Keywords: Alpha amylase inhibitory activity, Antioxidant activity, Medicinal plants

Bioremediation of Cadmium by Microbial Biofilms Developed Through Endophytic Fungi from Selected Mangrove Species and Soil Bacteria

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Cadmium is the most dangerous heavy metal characterized by high stability and toxicity even at low concentration. The potential use of metal-resistant microorganisms as an eco-friendly method in the treatment of heavy metal contaminated soil and water has become more important. Therefore, the biosorption removal of cadmium from aqueous solutions by using mono and mixed microbial cultures was investigated in this study. Twelve endophytic fungi were isolated from the leaves of *Avicennia marina* and *Lumnitzera racemosa*, whereas thirteen bacteria were isolated from the mangrove soil collected from the Puttalam lagoon in Puttalam district, Sri Lanka. Microbial isolates were grown in Potato Dextrose Agar and Nutrient Agar with different concentrations of Cd to select the most Cd resistant fungi and bacteria. Fungal-Bacterial Biofilms (FBB) were developed from the selected Cd resistant fungi and bacteria. The selected biofilms and mono cultures were inoculated in Cd supplemented Combine Carbon Broth (CCB) in the concentration range of 50-500 mg l^{-1}. Concentration levels of Cd in the CCB were measured periodically using Atomic Absorption Spectroscopy. Out of three fungal (LRA, LRC and AMA) and three bacterial (SB_2, SB_3 and SB_{12}) strains that showed the highest resistance against Cd, two fungal (LRA and LRC) and all three bacterial strains were selected for the formation of FBB. Screening assay revealed that LRA and SB_3 strains had significantly the highest resistance against Cd ($P < 0.05$). The lowest significant mean Cd concentration level in CCB was observed in $F_2B_1B_3$ biofilm (103.167 mg l^{-1}) that reduced the Cd concentration level by 58.74% after sixteen days of incubation ($P < 0.05$). Even though all the microbial cultures showed significant reduction of Cd concentration level, biofilms except $F_1B_1B_3$ (52.73%) showed much reduction than that of mono cultures. Thus, these results indicated the potential of biofilms to reduce the concentration of Cd in water very efficiently.

Keywords: Bioremediation, Cadmium, Biofilms

Evaluation of Cadmium Ion (Cd^{++}) Adsorption Ability of Banana Peels and Luffa Sponges

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Cadmium is highly used in industries and causes harmful effects on organisms. The use of low-cost, safe, environment friendly sorbents has been investigated to remove heavy metals from aqueous waste streams of industries. This study was carried out to evaluate the cadmium ion adsorption ability of banana peels *(Musa sapientum*) and luffa (*Luffa cylindrica)* sponges. Any chemical modifications were not used for plant materials during the experiment. Water with known initial cadmium (Cd^{++}) concentration was prepared by adding Cd ions to the cadmium free deionised water. Adsorptions were measured at three different plant material dosages of 0.25 g, 0.5 g and 1.0 g in 25 ml of deionised water with known Cd^{++} concentration of 5 ppm. All experiments were conducted under room temperature (27^{o}C). Atomic Absorption Spectrometer was used to evaluate the Cd^{++} concentrations of samples after treatments. Time duration for each trial was 120 minutes. During first 10 minutes all samples showed their maximum Cd^{++} adsorption ability. The highest adsorption of 0.3575 mg/g was given by 0.25 g/25 ml (0.01 g/1 ml) of banana peel powder. The lowest adsorption of 0.0778 mg/ g was given by 1.00 g/25 ml (0.04 g/1 ml) luffa sponge powder. The results showed the potential use of banana peel and luffa sponge as bio adsorbents for cadmium ions.

Keywords: Atomic absorption spectroscopy, *Musa sapientum*, Bio adsorbents, cadmium, *Luffa cylindrica*

Extraction of Crude Collagen from *Thunnus albacares* (Yellowfin Tuna) Skin and Determination of Antioxidant and Metal Chelation Activities of Its Hydrolysates

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Collagen is a dominant protein in connective tissues and highly valuable in food industry. Fish processing byproducts are good alternative source for collagen. The objective of this study was to develop a simple non-toxic method to extract crude collagen from Yellowfin tuna skin and to check functional properties of its hydrolysates. Extraction procedures were conducted using acetic acid and citric acid with 0.5 M concentrations. Based on 8% SDS-PAGE gel, type I collagens were identified. Enzymatic hydrolysis was done with Protease, Trypsin and Pepsin enzymes with different time combinations (0 h, 3 h, 6 h, 9 h, 12 h and 24 h) at 37 ˚C after adjusting to its optimum pH level. Best hydrolysate was selected and subjected to antioxidant activity by Diphenyl-1-picryhydrazyl (DPPH) radical scavenging activity and Metal (Fe^{2+}) chelating activity. Proximate analysis was conducted for raw skin to determine moisture, ash, crude protein, crude fat content and 59.44±0.013%, 1.91±0.37%, 28.55±1.19%, 6.83±0.30% values were obtained respectively. Hydrolysates produced after incubating for 0 h at 37 °C followed with heat inactivation was selected as the best. Hydrolyzed produced using citric acid showed lower scavenging activity (63.62%) compared to acetic acid (85.07%) ($p<0.05$). In both acetic and citric extractions Fe^{2+} chelating activity did not show significant difference among the treatments ($p>0.05$). According to the collagen hydrolysates incubated at 0 h at 37 ˚C showed good antioxidant activity with acetic acid extraction with Pepsin enzyme. This conclude that collagen hydrolysates produced using acetic acid and Pepsin showed good antioxidant activity comparing with the ascorbic acid as positive control and it could be deserved to use as good alternative source as a natural anti-oxidant in food industry.

Keywords: Fish collagen, Yellowfin tuna, Antioxidant activity, Hydrolysates

Evaluation of Oxalate Chelating Properties of Selected Egg White Proteins

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Ovalbumin, ovotransferrin, ovomucin are considered as the major egg white proteins which highly available in the egg white with remarkable functional properties such as anti-bacterial, anti-viral, metal chelating etc. Oxalate also a negative ion and anti-nutritive agent which provides precursor ions to form calcium oxalate kidney stones. According to the present studies, restriction of oxalate rich food is the main prevention factor. A very few studies have been investigated to scavenge the oxalate in the diet. Incorporating egg white proteins to scavenge oxalate will be beneficial, because egg white proteins are well known as natural proteins with many functional properties. Aim of the study was to evaluate the oxalate chelating properties of major egg white proteins: ovalbumin, ovotransferrin (Apo & Halo) and ovomucin. Oxalate (200 mg) were dissolved in 10 ml of distilled water and 0.4 g of proteins were added using triplicates separately. The samples were incubated at 4 °C for 24 hours. After centrifuging, supernatants were measured and directed to the HPLC analysis which has been carried out on RP18 column using the mobile phase of methanol: water (50: 50 v v^{-1}) with the flow rate of 1 ml min^{-1} and detection wavelength was 237 nm at 1.35 ± 0.5 min retention time. Among the four proteins ($P < 0.05$), ovalbumin was reported the highest chelating of oxalate (128.43±4.56 mg) and lowest value was shown in apo-ovotransferrin (50.57±1.94 mg). Ovomucin also showed the high chelation of oxalate (94.68±4.24 mg) which less than to ovalbumin. There was a significant difference among the ovalbumin and ovomucin. Whereas the holo-ovotransferrin was shown the oxalate releasing activity. Ovalbumin and ovomucin were shown very good oxalate chelating activity, compare to the apo-ovotransferrin. Therefore, there is a potential to develop nutraceuticals to scavenge oxalate with oxalate chelating properties of these proteins.

Keywords: Oxalate, Chelating, Egg white proteins

Determination of Antioxidant and Metal Chelation Activities of *Sepioteuthis lessoniana* (Squid) Ink Hydrolysates

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Big fin reef squid (*Sepioteuthis lessoniana*) is a widely distributed species in Northern coast of Sri Lanka and generates 52% of total body weight as waste due to high utilization in processing industry while causing a series of ecological problems and environmental pollution. As these by-products are a potential source of good bioactive compounds, this study aimed to analyze the bioactive properties of hydrolysates developed from squid crude ink. Ink sacs of *S. lessoniana* were collected and squeezed. Moisture, protein, ash and lipid content in crude ink were analyzed. Trypsin (1:100) was used in the preparation of enzymatic hydrolysates from lyophilized ink at pH of 7.8 by incubating at 37 °C for 0, 3, 6, 9, 12 and 24 hours followed by heat inactivation at 100 °C for 15 minutes. Best time course (3 hours) was detected using 15% SDS-PAGE and directed to develop chemical hydrolysates using 6 M NaOH (basic), 6 M HCl and 6 M Acetic acid (acidic) in 2:1 ratio respectively while incubating at 37 °C for 3 hours followed by heat inactivation at 100 °C for 15 minutes and 15% SDS-PAGE was conducted. DPPH radical scavenging assay was used to detect antioxidant activity while metal chelating activity was used to detect Fe^{2+} chelating activity in selected best hydrolysates. According to the proximate analysis, moisture and protein contents were 75.53±2.10% and 19.73±2.44% respectively in crude ink. DPPH scavenging assay showed a significant difference between the treatments ($p<0.05$) and Fe^{2+} chelating activity assay revealed that there was no significant difference among those three hydrolysates ($p>0.05$). However, highest DPPH scavenging activity and Fe^{2+} chelating activity values (61.54±2.96% and 30.35±3.91%) were obtained from acid hydrolysis. Accordingly, the study concluded that hydrolysates produced by incubating with 6 M HCl and 6 M Acetic acid for 3 hours followed with heat inactivation has better antioxidant and metal chelating activities compared to rest.

Keywords: Squid ink, Enzymatic hydrolysates, Chemical hydrolysates, Antioxidant, Metal chelating

Extraction of Crude Coconut Oil from Industrial Coconut Waste and Determination of Its Chemical Properties

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Coconut oil is one of the highly beneficial natural oil with many of the hidden medicinal values. High amount of low fat coconut residue and sludge water is removed from coconut processing industry without any use. This study was conducted to extract oil from coconut residue and sludge water in order to compare the properties of extracted oil. Oil was extracted from 10 L of industrial sludge water by density separation. Low fat coconut residue was taken and oil was extracted using solvent extraction technique. N-hexane and Di-ethyl ether were two solvents used. Coconut residue (5 g) was taken and both solvents were added separately 1:1, 1:2, 1:3, 1:4 ratios and kept in water bath for 04 different time intervals (2, 4, 6, 12 h) at 37 °C. Later, the solvent was separated from the residue and kept in oven at 40 °C to remove the solvent and the oil was obtained. The physicochemical parameters were determined by standard methods using commercial coconut as control. According to the statistical results, there was a significant difference between the yields of two solvents ($p<0.05$) with the best yield of for N-hexane in 1:4 ratio with 4 h retention time (20.14%), whereas yield obtained from sludge was 5.00%. Proximate analysis shown that the fat content in residual coconut was 28.33 ± 0.38%. According to the chemical analysis, peroxide (mg peroxide kg^{-1}), acid values and moisture content were 2.85±0.09, 1.39±0.01, 1.26±0.09, 1.59±0.01 and 1.36±0.03, 0.097±0.00, 0.099±0.00, 42.2±1.29, and 1.23±0.00%, 0.99±0.00%, 1.49±0.01%, 9.25±0.02% for commercial oil, hexane, ether extracted oils and sludge oil respectively. The TBARS results showed that oil extracted using hexane have less oxidation than control ($p<0.05$). This study concludes that low fat residue and sludge water is no longer wastage and it contains significant amount of oil with good chemical properties. However further studies need to check the composition in the extracted oils.

Keywords: Low fat, Sludge, Extraction, Chemical properties

Effect of Activated Carbon Produced from Spent Tea Leaves on Dechlorination of Water

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Dechlorination is the process that removes total residual chlorine from water. Activated carbon can be used as a dechlorinating agent as it is an excellent adsorbent. As a precursor material for producing activated carbon there is a possibility that spent tea leaves can be used, otherwise; they will be only an agricultural waste. The objective of the present study was to evaluate the possibility of removing total chlorine residuals present in water using activated carbon produced from spent tea leaves which was activated with H_2SO_4 and K_2CO_3. The produced activated carbon was used to filter chlorinated water which has different concentrations of total residual chlorine. Retention time during filtering was changed as 0, 15 and 30 min. For the precursor material and activated carbon, FTIR, XRD and ash testing were conducted. The results showed that there is a positive correlation between chemical activating agent, initial residual chlorine concentration and retention time. Minimum total residual chlorine in the filtrate was given by H_2SO_4 chemical activation agent with 30 min retention time. When the initial total residual chlorine concentration was ≤780 ppm, it removed 100% chlorine residuals in the water regardless of the retention time. The pH of activated carbon produced using H_2SO_4 chemical activation agent was 7.27 whereas the other one produced using K_2CO_3 showed 7.41. The column of activated carbon which is produced from spent tea leaves and chemically activated using H_2SO_4 can be used to filter chlorinated water effectively under 30 min retention time.

Keywords: Activated carbon, Chemical activation, Dechlorination, Spent tea leaves

Optimization of Fermentation Medium for Bioethanol Production from Palmyrah Molasses

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Molasses is the waste material obtained from the production of palmyrah sugar candy and it could be used for alcohol production through fermentation process thereby it reduces the production cost of sugar candy. The aims of the study were to select the best yeast species and optimize the fermentation conditions to produce ethanol. The best yeast strain for fermentation was selected according to their alcohol tolerance and growth on molasses using the cell density count in spectrophotometer. Molasses was tested for the chemical parameters such as brix, total sugar, reducing sugar, pH, total acidity and alcohol before using it as fermentation medium. Optimization of fermentation was carried out with different initial brix (5, 10, 20, 30, 40 °Brix), inoculum size (1, 2, 3, 4 ml), pH (4, 4.5, 5, 5.5, 6, 6.5) and temperature (30, 35, 45, 55 ˚C). Each treatment was triplicated under controlled environment conditions. Results indicated that the absorbance 0.508 and 0.788 were obtained as highest cell density for high alcohol (8.5%) tolerance and growth on molasses, respectively. The best yeast strain was used for further fermentation studies and recorded the initial brix, pH, total sugar and reducing sugar values as 58.73 ^{o}Brix 4.5, 62.39 and 8.06%, respectively while the alcohol content given nil. Brix 10^{o} and inoculum size of 3 ml were selected as the optimum at 3rd and 6th day of fermentation with mean value of 2.6 and 4.4 alcohol percentages among the different treatments. Optimum pH for the process was recorded as 4.5 and it gave the highest 4.6 alcohol percentage on 5th day while optimum temperature was 35 ˚C and resulted 4.8 alcohol percentages on 4th day. There was a significant decrease in total solids of all the treatments during the fermentation process. Bioethanol production from palmyrah molasses could be enhanced up to 72% by the optimization of fermentation condition (Brix, Inoculum size, pH, Temperature) using the selected yeast strain.

Keywords: Ethanol production, Palmyrah molasses, Yeast fermentation,

Study of Manganese Accumulation and Temporal Variation of Water Quality in *Badulu Oya*

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Demand of safe drinking water is gradually increasing with rising of population in Sri Lanka as a basic need of human. *Badulu oya* is the main water source for drinking water in Badulla District, Uva province. Recently manganese (Mn) concentration in Demodara reservoir which was made for the purpose of water treatment facility year-round has increased unsteadily from the Sri Lankan Standards for drinking water (0.1 ppm). Therefore, the present study was conducted to determine Mn accumulation in the reservoir and to identify temporal variation of physico-chemical parameters of water. Sixteen locations from disparate upper tributaries and the reservoir were selected for sampling and that was carried out from October 2018 to December 2018. Manganese concentration of water samples were determined using Atomic Absorption Spectrometer and other water quality parameters; Turbidity, TDS, Alkalinity, Hardness were measured using standards methods. Data were statistically analyzed using SPSS 23.0 package. There was a significant difference of Mn concentration in the reservoir (06°54'47.0016" N, 081°03'38.0016" E) with the time ($p<0.05$) and with the location ($p<0.05$). Average Mn concentration in the reservoir (0.12 ppm) was significantly higher than the average Mn concentration of all other sampling sites (0.02 ppm). Average turbidity of the reservoir was correlated with average turbidity of all other sampling sites ($r=0.855$). Average TDS (53.25 ppm), Alkalinity (36.40 ppm), and Hardness (44.22 ppm) of reservoir were lower than the average value of all other sampling sites (60.96 ppm, 51.22 ppm, 49.77 ppm respectively). The results of this study will be helpful to take necessary actions to mitigate accumulated manganese of reservoir. Agricultural and industrial activities as mining of quarries may cause to adversely change the water quality parameters of Demodara reservoir. But more studies are needed to find out reason(s) for reservoir has higher Mn concentration.

Keywords: Drinking water, Water treatment, Physico-chemical parameters

Preliminary Screening of Marine Algal Species for Isolation of Bioactive Compounds from *Caulerpa racemosa, Sargassum crassifolium* and *Ulva reticulata*

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Phytochemicals have been proved to be a reliable pharmaceutical source having beneficial biological activities for the treatment ailments in traditional medicines. In this context, seaweed species have been concerned as one of the important phytochemical sources. The current study explored three seaweed species, *Caulerpa racemosa*, *Sargassum crassifolium* and *Ulva reticulata*. Samples were collected from the southern coast of Sri Lanka and identified to the species level using species keys for macroalgae. The samples were processed to remove foreign material and shade dried prior to two different extraction protocols. As a preliminary step for the identification and isolation of target compounds, the extracts were driven through different screening protocols. Extraction protocols were followed for the phytochemical screening and DPPH scavenging activity separately. Sequential extraction was followed for the assessment of antioxidant activity. Terpenoids, steroids, phenolic compounds, flavonoids, saponins and alkaloids were present in all three species in detectable levels. Considering DPPH radical scavenging activity, methanolic extract of *C. racemosa* has shown significantly higher activity with a mean of 54.41% and methanolic extract of *U. reticulata* has shown a significantly lower activity with a mean of 36.76%. Methanolic extracts of *C. racemosa* and *S. crassifolium* and ethyl ether extracts of *U. reticulata* and *S. crassifolium* have shown significantly higher radical scavenging activity. Water has shown poorer radical scavenging activity for all three species. Based on the results obtained, all three species have active compounds. Polar fractions of *C. racemosa* and *S. crassifolium* and non-polar fractions from *U. reticulata* suitable to use for isolation of bioactive compounds. It is suggested to carry out isolation activities for significantly higher activity fractions of the extracts which could be used to identify appropriate solvent extraction.

Keywords: Marine algae, Bioactive compounds, DPPH, Antioxidant activity, Extract

Effect of α-Pinene on the Soil Bacterial and Fungal Population and Soil Organic Carbon in Eucalyptus Plantations

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Nutrient cycling is essential for the stability of an ecosystem where soil microorganisms play a significant role. Some allelochemicals such as α-pinene produced by certain plant species may suppress the activity of these microorganisms. Eucalyptus, which is a popular plantation species in Sri Lanka, is known to emit α-pinene. However, its effect on soil microorganisms and soil fertility is not well known. The present study investigated the relationship between α-pinene content, soil microorganisms and soil organic carbon content in 7-year-old *Eucalyptus grandis* and *Eucalyptus torelliana* plantations. As the control plantation, an adjacent Patna grassland (previous land-use before afforestation) was used. Three subplots (20 × 20 m) were established within each site and soil was sampled up to 15 cm depth. Soil organic carbon content was measured according to the Walkley-Black method. Following a serial dilution, bacteria and fungi were cultured and CFU mL^{-1} was calculated. The α-pinene in soil samples was extracted using petroleum ether and was analyzed using GC-MS. According to the results, there was a significant (P<0.05) variation between organic carbon, α-pinene content and bacteria quantity between the plantations and the adjacent grasslands. However, there was no significant (P>0.05) variation in fungi quantity. The highest organic carbon content was observed in *E. torelliana* plantation (2.08% ±0.3), however; the highest α-pinene content was found under *E. grandis* plantation (0.14% ± 0.09). Interestingly, the highest bacterial count was recorded under *E. grandis* plantation (3.0×10^5 CFU mL^{-1}) while the highest fungi count was recorded in grassland. There were no significant (P>0.05) correlations between the soil α-pinene content, soil bacterial and fungal count fungal and the organic carbon. There is no significant effect (P>0.05) of α-pinene content on the bacterial and fungal counts and organic carbon in young *E. grandis* and *E. torelliana* plantations.

Keywords: Eucalyptus, α-pinene, Bacteria, Fungi, Organic carbon

Efficiency of Manganese Removal by *Eichhornia crassipes* and *Pistia stratiotes* from Contaminanted Water

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Metal pollution is a major problem of water sources used for drinking purposes. Among heavy metals, Manganese (Mn) is an essential trace element for the functioning of human, animal and plants but it leads to toxicity when it exceeds the standard level. *Phytoremediation* can be applied to remove heavy metals from aquatic environment. Floating aquatic macrophytes are used as an environmental friendly, efficient and cheap method. In presence study two aquatic plant species, *Eichhornia crassipes* (Water Hyacinth) and *Pistia stratiotes* (Water Lettuce) were used to determine the efficiency of removing Manganese. Bioassays using Water Hyacinth and Water Lettuce were carried out with de-ionized water contaminated by three concentration series (20, 40, 60 mg L^{-1}) of Manganese (II) for a period of 24 days. Three replicates were carried out for each series. Water samples were taken from each series at one day intervals and remaining manganese were analyzed using Atomic Absorption Spectrometry technique. Variations of pH and electrical conductivity of water were also measured as same interval by standard techniques. Data were statistically analyzed using SPSS16.0 package. Both *Eichhornia crassipes* and *Pistia stratiotes* showed the highest removal efficiency at the lowest concentration of Manganese (20 mg L^{-1}). Average efficiency of manganese removal from water by *Eichhornia crassipes* and *Pistia stratiotes* were 67.61% and 80.04% respectively. Higher manganese removal efficiency was observed in *Pistia stratiotes* than *Eichhornia crassipes.* There was a significant difference ($p<0.05$) between absorbed manganese concentrations with the time in *Eichhornia crassipes*, but there was no significant difference ($p>0.05$) in *Pistia stratiotes*. The results of the study revealed that the both plants can be used to remove manganese from contaminated water. However, it is needed to conduct a pilot study for the water contaminated with manganese.

Keywords: Eichhornia crassipes, *Pistia stratiotes*, Manganese, Phytoremediation, Efficency

Reduction of Enzymatic Discolouration of Natural Rubber Latex by Using Antioxidant and *Moringa oleifera* Leaf Extract

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Natural rubber latex tends to discolour due to enzymatic activity. This should be avoided to maintain the quality of natural rubber latex. Natural rubber latex of RRISL 203 clone shows higher degree of enzymatic discolouration due to the presence of phenolic substances. The objective of this study was to find a solution to reduce the enzymatic discolouration of latex of the above clone using natural and commercial antioxidants. Leaf extract of *Moringa oleifera* has been evaluated for its antioxidant activity as it contains higher amount of powerful antioxidant quercertin. Three treatments: *M. oleifera* leaf extract, Vitamin C (a solution made by dissolving vitamin C tablets) and 'antioxidant *G'* (is a natural antioxidant) were used to perform antioxidant activity in latex obtained from RRISL 203 clone. Three replicates were done for latex samples obtained from three tapping blocks. Each solution of antioxidant was added separately prior to add formic acid to latex. Samples were prepared as unfractioned-unbleached crepe rubber with a control. Samples were analyzed for Mooney viscosity, Plasticity Retention Index, Volatile Matter Content and Ash Content. Further, colour index test was done for the colour comparison which determine the enzymatic discolouration. There was no significant difference ($P>0.05$) in raw rubber properties among the treatments whereas significant difference ($P<0.05$) among treatments for the colour index was observed. Lowest colour index values (1, 1.5 and 2.0) were resulted by the 'antioxidant *G*' in three blocks as compared to the other treatments. Crepe samples prepared by treating Vitamin C and leaf extract of *M. oleifera* were inferior in colour as compared to the 'antioxidant *G'* treated samples. It can be concluded that 'antioxidant *G'* can be used effectively to reduce the discolouration of natural rubber latex while maintaining its properties satisfactorily.

Keywords: Antioxidant, Crepe rubber, Discolouration, Leaf extract, *Moringa oleifera*

Screening for Antibacterial Potential of Marine Algae Extracts from West Coast of Sri Lanka

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Marine algae are produced wide variety of bioactive compounds and some of them can be used to development of antibacterial novel drugs. The present study was aimed to evaluate antimicrobial activity of some marine algae extracts from west coast of Sri Lanka. Pure cultures of *Escherichia coli*, *Pseudomonas aeruginosa*, Staphylococcus *aureus*, *Enterococcus faecalis* and *Pectobacterium carotovorum* were used as the test microorganisms for antibacterial testing. Marine algae such as *Ulva prolifera*, *Chaetomorpha antennina*, *Cladophoropsis sundanensis*, *Sargassum crassifolium*, *Asteronema breviarticulata*, *Chnoospora minima*, *Gracilaria multipartita*, *Gracilaria folifera*, *Gracilaria hikkaduwensis*, *Rhodopeltis* sp., *Grateloupia lithophila* and *Laurencia natalenis* were collected from Kalpitiya sea coast. They were freshly ground and 25 g of each fresh algal sample was extracted in 50 ml of distilled water, methanol, acetone, diethyl ether separately and concentrated to 0.5 g/ml following solvent extraction at 30 ^{o}C. The test bacteria of 10^{8} CFU/ml were introduced and uniformly spread on the surface of Muller Hinton agar plates separately and followed standard agar –gel diffusion inhibition procedure. After placing 25 µl of extracts into each well, plates were incubated at 37 °C and 30 ^{o}C respectively for 24 hours and the diameter of the growth inhibition zone around the wells were measured. Comparisons were performed using one-way ANOVA followed by Duncan multiple-range test. It was revealed that the all tested extracts of *C. minima* showed antibacterial activity against *S. aureus* and all extracts of *G. folifera* against *E. faecalis*. Methanolic, acetone and diethyl ether extracts of *G. hikkaduwensis* inhibited the growth of *S. aureus*. Further, methanolic extracts of *A. breviarticulata*, *S. crassifolium* and *U. prolifera* showed inhibitory effect against all tested bacterial species. Finally, it can be concluded marine algae from Kalpitiya coast of Sri Lanka are potential sources of bioactive compounds and should be investigated for identifying natural antibiotics.

Keywords: Marine algae, Antibacterial activity, Agar- gel diffusion, Growth inhibition zone

Surface Modification of Cellulose Micro Fibrils Extracted from Banana Pseudo-Stem Using Bis-[3-(triethoxysilyl) propyl] tetrasulfide

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Cellulose as the most abundant biomolecule on the earth, it is on investigations to be used in several applications as a remedy for the exploitation of non-renewable resources and mismanagement of agro-industrial wastes. Banana (*Musa sapientum*) fibre is a promising source of cellulose which can be derived after harvesting while the majority of the pseudo-stems are used as a low-cost feedstock for the preparation of compost. However, the cellulose itself is not compatible with most of the materials especially, with non-polar matrices. Therefore, the extracted cellulose has to be surface modified. In this study, micro-fibrillated cellulose was prepared following an alkali treatment coupled with high-pressure defibrillation and acid treatments on fibre extracted from pseudo-stem. The resulted micro-fibrillated cellulose was characterized using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and cellulose structure was confirmed. XRD studies showed 69% crystallinity of micro-fibrillated cellulose. The particle size shows a bimodal distribution where approximately 21% of the sample has an average size of 110 nm and the rest is in averaged 795 nm. The prepared micro-fibrillated cellulose was surface modified using Bis-[3-(triethoxysilyl) propyl] tetrasulfide (TESPT) following rigorous solvent extractions with ethanol and acetone through cellulose membrane. With the surface modification, the percentage crystallinity has increased up to 77.8%. Moreover, the surface modification was confirmed by the results of FTIR spectroscopy showing the stretching vibration of Si-O-C bond at 1031 cm^{-1} indicating that the surface modification was successful.

Keywords: Agro-industrial wastes, Banana fibre, Micro fibrillated cellulose, TESPT

A Novel Method to Manufacture Skim Crepe Rubber with Low Nitrogen Content using Pineapple Juice Treated Skim Latex

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Skim Natural Rubber Latex (SNRL) is a by-product obtained during the manufacture of centrifuged latex, contains low dry rubber content (<5%). Direct coagulation of SNRL with concentrated sulfuric acid is the conventional method used to manufacture Skim Crepe Rubber (SCR). SCR fetches a low market value due to its inferiority in quality inherited by the presence of higher non-rubber content compared to that in other raw rubber types. This study focused to develop a healthier and environmental friendly manufacturing process for SCR with lower nitrogen content and higher quality through removal of protein. Pineapple juice (PAJ) was initially treated with Potassium oleate before it was mixed with SNRL (15 ml of PAJ was added to 1 L of SNRL) and kept for 48 hrs at room temperature (28 ^{o}C). Then a creaming agent was added at 25 phr to PAJ treated SNRL after adjusting pH to 7.5 and creamed for 36 hours. Three different acidic coagulants of 20% (w/w): sulfuric, oxalic and formic acid were employed to coagulate deproteinized creamed fraction. The control sample of SCR was also prepared by adding 20% (w/w) sulfuric acid to fresh SNRL. Raw rubber properties were evaluated according to the ISO standards. All SCR samples prepared by using creaming followed by the PAJ treatment have low nitrogen content (0.300.40% w/w) and Mooney viscosity (7590 MU) along with higher ash content (0.4-0.5% w/w) than the control sample where above parameters were 1.44% (w/w), 91.55 MU and 0.17% (w/w) respectively. It was found that total acid requirement could be reduced by 50% using novel method. Also deproteinized SCR manufactured using oxalic acid as the coagulant has highest Plasticity Retention Index (61.17%) with good initial Plasticity. This method might be a good solution for removal of protein substances and unfavourable metal ions from SNRL enhancing the quality of SCR. Therefore, this novel method would allow to obtain a better competitive commercial value for SCR.

Keywords: Creaming, Deproteinization, Pineapple juice treatment, Skim natural rubber latex

A Comparison of Richness, Diversity and Antibacterial Producing Capacity of Endophytic Fungi of *Cyperus iria* from Three Geographical Locations in Sri Lanka

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Endophytic fungi living inside healthy tissues of plants are a well-established source of various biologically active secondary metabolites. Although sedges are known to harbor numerous endophytic fungi, endophytes inhabiting sedges of the family Cyperaceae have been sparsely investigated. Therefore, the current study was designed to investigate the endophytic fungal richness, diversity and the antibacterial producing capacity, of the *Cyperus iria* from three geographically distinct locations in Sri Lanka. Endophytic fungi were isolated from surface sterilized aerial and root segments of healthy *C. iria* collected from Badulla, Matale and Colombo Districts and crude ethyl acetate fungal extracts were tested for antibacterial activity against four selected bacteria; *Staphylococcus aureus*, *Bacillus cereus*, *Pseudomonas aeruginosa* and *Escherichia coli* at 400 µg/disc concentration using agar disc diffusion method where Gentamycin (10 µg/disc) and methanol were used as the positive and negative controls, respectively. Isolated endophytic fungi were identified using molecular techniques. Endophytic fungal richness of *C. iria* from the three locations namely Badulla, Matale and Colombo were 17, 34 and 23 respectively and 12, 23 and 13 fungi were isolated from aerial parts while 05, 11 and 10 fungi were isolated from root segments. Accordingly, more fungi were isolated from aerial parts than from roots. Among the isolated fungi *Fusarium*, *Curvularia*, *Trichoderma*, *Penicillium* species were the most abundant. With respect to antibacterial activity, all endophytic fungi isolated from Badulla plants, 85 % from Matale plants and 82 % from Colombo plants showed activity against at least one bacterium tested. Also irrespective of the location of the plant most fungal extracts showed activity against the Gram positive than the Gram negative bacteria. In conclusion, endophytic fungi of *C. iria* from all three locations showed a high fungal richness and a majority showed antibacterial activity.

Keywords: Endophytic fungi, Antibacterial activity, *Cyperus iria*, Gram positive

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Extraction of Crude Skin Collagen from *Pterygoplichthys pardalis* and Determination of Antioxidant and Metal Chelation Activities of Its Hydrolysates

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Collagens have a great demand in the food industry and fish skin is a safe alternative source of collagen. *Pterygoplichthys pardalis* is a freshwater fish which threatens endemic fish and inland aquaculture, and has no economic benefit. Objective of this study was to extract crude collagen from *P. pardalis* skin with simple and non-toxic method followed by identifying the antioxidant properties of its hydrolysates. Proximate composition was determined in raw fish skins with and without bony plates separately. Acid and Pepsin soluble collagens were extracted from *P. pardalis* skin. As with the pretreatment process of citric acid (CA) and EDTA were tested to decalcify the fish skin. Three different concentrations were used with CA as 1.2, 2.2 and 3.2 kgm^{-3} and for EDTA as 0.1, 0.2 and 0.3 M. Selected crude collagens were subjected to the hydrolysis using Pepsin, Protease and Trypsin enzyme after adjusting to its optimum pH with different time combinations (0, 3, 6, 9, 12 and 24 h) at 37 °C followed by heat inactivation at 100 °C for 15 min. Extracted crude collagen and best hydrolysates were selected by 8% and 15% SDS-PAGE respectively. Antioxidant activity of the best hydrolysates was evaluated using DPPH scavenging assay and metal chelation activity by Fe (II) chelating activity. All treatments were replicated (n=3). Raw fish skins with and without bony plates contained 44.29±3.69%, 58.79±1.05% moisture, 16.40±0.93%, 5.38±1.61% ash, 26.75±8.93%, 26.89±3.25% crude protein respectively. Extracted collagens with CA treatment showed higher yield compared to EDTA treatment ($p<0.05$). The Antioxidant properties were not significantly different ($p>0.05$) but metal chelation activities of selected best hydrolysates were higher in CA than EDTA treatment ($p<0.05$). These results conclude that collagen hydrolysates produced from *P. pardalis* with all three enzymes with 0 h at 37 °C followed by heat inactivation have good antioxidant and metal chelating properties.

Keywords: Fish collagen, Enzyme hydrolysis, Antioxidant, Metal chelating

Determination of Antioxidant and Metal Chelating Activities of Water Extracted *Lepidocybium flavobrunneum M*uscle Protein Hydrolysates

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Lepidocybium flavobrunneum is a marine fatty fish also known as Escolar fish. Due to laxative effect and histamine poisoning many countries reject its consumption as a food leading to wastage of the fishery resources. The objective of the study was to determine the antioxidant and metal chelation activities of Fish Protein Hydrolysates produced from water extracted crude proteins of *L. flavobrunneum* muscles. In this study Escolar fish muscle was separated from skin and mixed with water according to 1:1, 1:2, 1:3, 1:4 ratios and they were observed under 10% SDS-PAGE gel. Crude extraction was lyophilized and hydrolyzed using Pepsin, Protease and Trypsin enzymes (1:100) under 37 °C at optimum pH conditions for 0, 3, 6, 9, 12 and 24 hours followed by heat inactivation at 100 °C for 15 minutes. Samples were examined for antioxidant activities by TBARS assay, DPPH scavenging assay, and metal chelation activity by Fe (II) chelating activity method, followed by statistical analysis of results. Since there was no any significant different between yields ($p>0.05$), 1:1 ratio was selected as the best extraction method. 3 hours was selected as the time of hydrolysis, for all enzyme treatments by observing 15% SDS-PAGE gel images. According to results obtained from both TBARS assay and DPPH scavenging assay did not show any significance difference ($p>0.05$). Infact all hydrolysates showed oxidative activities while Fe (II) chelating was high in hydrolysates produced from Trypsin enzyme (37.45±3.33%) compared to rest ($p>0.05$). Accordingly, the study concluded that hydrolysates produced from incubating with Trypsin for 03 hours followed with heat inactivation has better metal chelating activities compared to other hydrolyzing treatments.

Keywords: Escolar fish, Bioactive compounds, Extraction, Hydrolysates

Comparative Study on Antioxidant Activity and Antimicrobial Activity of *Sargassum ilicifolium* Crude Extract Using Different Solvent Extractions

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Seaweeds are used for food, pharmaceutical and biochemical applications as they possess interesting biological activities. Amongst seaweeds, brown seaweeds show excellent antimicrobial, antioxidant and antiviral properties. *S. ilicifolium* is an economically important, underutilized seaweed species where more research opportunities are available. Hence, the present study was conducted to determine the functional properties of crude extracts of *S. ilicifolium* to find the best extract to develop as an ingredient for food industry. Dried and coarsely powdered samples of *S. ilicifolium* were subjected to solvent extraction using methanol, ethanol, chloroform and acetone. The yield, proximate analysis of crude extracts was determined while antioxidant activity was determined using DPPH and TBARS assays. Antimicrobial activity was determined against the *Staphylococcus aureus*. Significantly highest extraction yield was recorded in methanolic extraction (17.18±3.20%) while 9.60±2.14%, 2.80±0.59%, and 3.60±0.37% yields were obtained from ethanol, acetone and chloroform extractions, respectively ($P<0.05$). The highest carbohydrate (37.64±1.1%) and moisture (14.07±0.71%) were observed in methanolic crude extract. Highest ash content (37.15±4.90%) was observed in ethanolic crude extract. DPPH scavenging activity of the dried seaweed, methanolic and ethanolic crude extractions were 5.32±0.35%, 21.47±2.81%, 14.93±2.55% respectively ($P<0.05$). The malonaldehyde produced in dried seaweeds, chloroform and acetone extractions were recorded higher while ethanolic, methanolic extractions were showed lower than control. Antimicrobial assay against *S. aureus* did not show resistant to all the seaweed extracts. Hence, it could be concluded that the presence of bioactive components in the crude exacts of *S. ilicifolium* while highest components in ethanolic and methanolic extracts. Therefore, the ethanolic extract of *S. ilicifolium* could be a potential source as an ingredient for food industry.

Keywords: Seaweeds, *Silicifolium*, Crude extract, Bioactive compounds, Food industry

Development of a Simple Nontoxic Method to Extract Crude Fish Oil from Yellowfin Tuna (*Thunnus albacares)* Offal

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Among world fish processing industry yellowfin tuna is a dominating species that is responsible for high amount of waste generation during processing which makes a high level of by-product. Fish by-products consist with omega-3 poly unsaturated fatty acids that are vital in food and pharmaceutical industry. The study was targeted to develop an effective fish oil extracting method from yellowfin tuna gut comparing with a current existing extraction technique. The determined proximate composition of yellowfin tuna gut showed 4.87±0.2% of crude fat. The research was conducted with completely randomized design (CRD) with two treatments; wet press method (rendering) and the solvent extraction method. As the solvents Chloroform/Methanol (standard), Acetone, Petroleum ether, n-Hexane, n-Butanol and Ethanol were used separately in 1:2 ratio (Gut sample: Solvent). Finally fish oil yields were calculated on percentages and analyzed the chemical property indices (Iodine value, Peroxide value and Acid value) of extracted fish oil. The results revealed that the highest yield (88.63±2.76%) was obtained in wet press method. In solvent extraction Acetone performed the highest yield (75.26±1.85%) showing the significant difference in comparison with oil yields of Petroleum ether, Hexane, n-Butanol and Ethanol ($p<0.05$).Iodine value of extracted fish oil from wet press method, Chloroform/Methanol**,** Acetone, Petroleum ether, n-Hexane, n-Butanol and Ethanol were 109.99±0.57, 103.94±0.56, 104.70±0.47, 104.53±0.74, 103.43±0.37, 106.15±0.86, and 105.83±0.68 respectively. The obtained peroxide value (2.98±0.05) and Acid value (1.04±0.02) of wet press method also indicated higher values than the solvent extraction method which assures that solvent extraction had a low hydrolysis and low oxidation in comparison with the wet press method. As conclusion extraction with acetone is better comparing the quality of the oil extracted.

Keywords: Fish oil, Extraction, Solvents, Omega-3, Oil yield

Comparison of Oil Yields and Chemical Composition of Selections of Cymbopogon Winterianus and *Cymbopogon nardus*

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Citronella (*Cymbopogon nardus* and *Cymbopogon winterianus*) is commercially cultivated for oil extraction and Cinnamon Research Station has developed and issued several citronella selections; three superior 'Heenpengiri' (HGC 01, EBC 02, and EWC 01) and two superior 'Mahapengiri' (KSC 04 and CRC 16) to conserve the wide genetic variability and provide high yielding citronella plant materials. However, a proper scientific analysis on chemical composition and yield of these developed selections has not been carried out. This study was focused on quantitative and qualitative analysis of oil extractions from five selections mentioned above. Steam distillation technique was used to extract the citronella oil; and gas chromatography equipped with Agilent DB WAX UI column was used to analyze the chemical composition of extracted oil. This experiment was carried out using Complete Randomized Design with three replicates. According to the overall analyses, HGC 01 has high quality than other two Heenpengiri selections as it contained Citronellal (3.45%), Citronellol (8.53%) and Geraniol (18.95) values with standard while KSC 04 contained Citronellol (9.12%), Geraniol (34.74%) and Limonene (1.58%) at 95% significant level and it is better than CRC 16. The results showed that there were no significant differences between the oil yield of EBC 02 and HGC 01, HGC 01 and EWC 01 selections. The oil yield of KSC 04 was significantly higher (P=0.045) than that of CRC 16. In conclusion, HGC 01 from *Cymbopogon nardus* and KSC 04 from *Cymbopogon winterianus* can be recommended as best selections for commercial extractions.

Keywords: Citronella, *Cymbopogon nardus*, *Cymbopogon winterianus*, Selections

Investigation on the Possibility of Harnessing Biogas from Spent Tea Leaf

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Made tea is generally used as raw material in instant tea manufacture. Spent tea the materials left after extraction of water soluble components from made tea is discarded as a waste material in instant tea manufacture. Discarding this solid waste is a costly and problematic operation. Spent tea is rich in nutrients but no effective method has yet been developed to utilize it. This study was conducted to investigate the potential of utilizing spent tea leaf in biogas production. An experiment was conducted using five different combinations (percent by mass) of spent tea leaf and cow dung as 100:0, 99:1, 80:20, 50:50 and 0:100, by using laboratory scale biogas reactor set-ups. Biogas production was measured daily by means of water displacement technique. Biogas generated (mL kg^{-1} of dry matter) by the above treatments were 1101.8, 988.33, 2126.17, 2069.33 and 0 respectively. Volume of biogas generated by the mixture of 80% of spent tea leaf and 20% of cow dung (2126.17 mL kg^{-1} of dry matter) was significantly ($P<0.05$) higher than that of other mixtures. Spent tea leaf can be used effectively in biogas production. Further research is suggested to optimize the process and to evaluate its feasibility.

Keywords: Spent tea leaf, Biogas, Cow dung, Instant tea

Use of Host Volatile, Pentanol as the Pheromone Synergist for Management of Red Palm Weevil

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Red palm weevil (RPW) *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae) is a devastating pest of coconut and other palms species in Sri Lanka and other countries. Being the conceal habitat of the pest inside the palm trunk, management of the pest is difficult and prevention of the pest damage is more important. Pheromone trap is one strategy popularizing among farmers as green pest management method. Increasing the efficiency of aggregation pheromone is a challenge. Use of responsive host volatiles for pest management is a recent trend in the field of pest management. Both electrophysiological and behavioral studies were carried out to select and formulate synergistic semiochemical formulation from six host volatiles and RPW aggregation pheromone. Electroantennogramme (EAG) test results indicated, the highest EAG response (-7.476 ± 0.713, -8.310 ± 0.332 mV) to pentanol from both female and male respectively. It is always higher than RPW aggregation pheromone (-5.402 ± 0.562, -4.310 ± 0.599 mV) and other tested five host volatiles. Behavioral studies indicated that, pentanol is an attractive volatile and 82 ± 3.74% attracts towards the pentanol applied coconut fronds than hexane applied fronds. Further, dose response of EAG, EAG and behavior studies indicated that, pentanol: pheromone at 1:1 mixture gave the highest response and attraction for both female and male (-6.49 ± 2.134, -10.376 ± 5.35 mV) among the tested mixtures of 1:1, 1:2, 1:3, 1:4, 1:5, pheromone alone and pentanol alone. Therefore, pentanol: pheromone at 1:1 formulation can be recommended for use as a semiochemical lure for RPW mass trapping after conducting mass trapping experiments in the field.

Keywords: Electroantennogramme, Host plant volatiles, Mass trapping, Pheromone synergist, Red palm weevil

Identification of Retting Enhancing Microbial Strains in Coconut Fibre Extraction

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Coir fibre is extracted from coconut (*Cocos nucifera* L.) husk. Natural retting process needs at least 3 months period for obtaining good quality bristle fibre. This study was carried out to reduce the retting time by introducing previously identified pectin and cellulose degrading microbial strains from bio chemical tests. For this experiment, coconut variety of CRIC60 from Bandirippuwa estate in Lunuwila was used. Retting experiments were carried out using five different combinations of microbes namely, *Serratia rubidea*, *Bacillus safensis, Bacillus thuringiensis* and *Staphylococcus sciuri.* The control was water. The experiment was carried out for two months. The coconut husk samples were collected by two week intervals and Ceylon drum machine was used for the fibre extraction. The percentages of bristle fibre and its qualities were analyzed. The ret liquor samples were also analyzed for pH and Electrical Conductivity. Tensile strength (118.39±1.9 N mm^{-2}), breaking load (3.27±0.36 N), average length (127.11±2.39 mm) and fineness (27.26±3.33 g km^{-1}) of initial sample were found to be increased to 145.48±3.97 N mm^{-2}, 4.35±0.28 N, 152.01±2.52 mm and 57.29±1.31 g km^{-1}, respectively with the treatment of coconut husks with *Staphylococcus sciuri, Serratia rubidea, Bacillus safensis, Bacillus thuringiensis* mixture for 4 to 8 weeks. Further, impurities (%) was reduced from 3.07±0.25 to 1.06±0.20 with this treatment. These values were satisfied with SLS Standards. Fibre percentage and the quality of ret liquor indicated by pH and Electrical Conductivity were also increased. Good quality bristle fibre can be obtained from coconut husks by treating with *Staphylococcus sciuri, Serratiarubidea, Bacillus safensis, Bacillus thuringiensis* consortium for 4-8 weeks.

Keywords: Coconut fibre, Retting, *Staphyococcussciuri, Serratiarubidea, Bacillus spp.*

Development of a Protocol to Reduce the Total Dissolved Solids in Effluent Treatment Plant Water

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Physico-chemical analyses of effluent treatment plant water of activated carbon manufacturing factory indicate that it has high total dissolved solids. Main reason for this high total dissolved solids is the availability of high amount of sulfate ions in effluent treatment plant water. Therefore, the aims of this study were to develop an effective method to reduce the total dissolved solids level in effluent treatment plant water and to release quality water to the environment after improving the effluent treatment process. The experiment was conducted in five stages. In first stage, 4 g of calcium hydroxide was added to precipitate calcium sulfate. In second stage, 1 g of calcium hydroxide and 1 g of aluminum were added to form ettringite and in third stage, the decant was passed through 500 g of sand filter. In fourth stage, filtrate was passed through 300 g of resin and finally pH was adjusted using carbon dioxide. The addition of lime and aluminum in second stage combines with soluble sulfate and forms calcium-aluminum-sulfate compound known as ettringite. The formation of ettringite can remove other types of heavy metals also. Quality parameters of water were determined by using MYRON L- Ultra meter II- 4P II, Eco Testr pH 2 and nephelometry method of sulfate determination. The results showed that the initial total dissolved solids level of 8900 ppm in effluent treatment plant water could be reduced to 2500 ppm. It can be concluded that this developed treatment process is capable of reducing the initial total dissolved solids in effluent treatment by 70%.

Keywords: Effluent treatment plant water, Ettringite, Five stage treatment process, Total dissolved solids, Water quality

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Optimization of Rabin Karp Pattern Matching Algorithm Based on Parallel Computing Techniques for DNA Sequence Analysis

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String matching algorithms are used to discover the occurrences of a defined pattern in a given text or a pool of strings which is widely used in detecting plagiarism, spam filtering and most importantly in computational biology including DNA sequencing. The existence and the intensity of a muted sequence in DNA caused for various diseases can be identified using Rabin Karp string matching algorithm. The main contribution of the study is to bring an efficient version of Rabin Karp algorithm by minimizing the spurious hits while using both Central Processing Unit (CPU) parallel techniques and General Purpose Graphics Processing Unit (GPGPU) parallel techniques specifically for DNA sequence analysis. The improved Rabin Karp is implemented using C language with POSIX Threads library, OpenMP and MPI and using Compute Unified Device Architecture (CUDA). When accelerating computations based on GPU, a special consideration has given to global memory, shared memory and texture memory, the types of memories with particular importance offered in CUDA architecture. By experimental studies, we investigated a new method to eliminate brute force matching and the GPU optimization is presented with stencil method ensuring efficiency in terms of memory overhead due to redundant data access in the serial CPU implementation. We have compared these parallel implementations for evaluating the effect of varying number of threads per block as well as varying DNA file sizes. The results obtained in this study present that the proposed implementation provides acceleration surpassing 36x speedup for string size 2^{20} characters compared to a sequential (CPU) implementation. Eventually, using the empirical results, we could conclude that the improved CUDA C implementation of shared memory version can achieve 35 times of performance than serial implementation for a large pool of DNA data in string matching.

Keywords: Rabin karp, GPU, CUDA, Pthread, String matching

An Improved Intelligent Elevator Control Model Using Image Processing and Fuzzy Logic

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Elevators are an efficient method of transporting passengers and goods in high rise buildings. But with increased complexity of the operational context, an elevator control system should consider user preferences and their behaviours, while addressing existing inadequacies. As per the results obtained from a statistical survey, above 70% expected modifying the existing system. Accordingly, a novel Elevator Group Control Model is introduced, based on a Destination Control Optimization algorithm. This algorithm directs passengers to elevators, concerning the weights of requesting passenger, other waiting passengers and passengers inside the destined elevator. Image processing has been proposed to detect passengers inside and outside the elevator. This avoids accepting requests in the absence of passengers. Unnecessary power is also turned off inside elevators in the absence of passengers. A mobile application reserves elevators for special purposes, only when absolutely necessary, as they can contribute on growing traffic. Fuzzy logic is used to determine the optimum elevator from a list of available elevators. A proof of concept is used to test the feasibility of proposed functions in the algorithm. Arduino platform is used to model elevator operating environment, while a haar cascade classifier is used as the image processing technique for passenger detection. The mobile application is based on Android technology. Finally the model was tested for user acceptance by conducting a simple survey. Each feature of the model was accepted by more than 80% of the respondents. Control algorithm tracks details of each elevator request, which can be used for predictive analysis on decision making with dynamic elevator traffic.

Keywords: Elevator, Destination control algorithm, Haar cascade classifier, Image processing, Fuzzy logic

Person Re-Identification and Tracking for Surveillance Camera Systems

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Person re-identification is a contemporary trend of technology, which is used to identify identities of people over a network of the camera system. Most person re-identification systems are working based on the colour histogram matching method. The problem is challenging due to the low resolution of videos, vary of illumination, positional variances and the possible appearance of carried objects at exclusive viewpoints. Another problem is when wearing the same clothes may be detected as they are the same person. Therefore, these kinds of person re-identification systems get low accuracy results. Hence, we focus our research on using comprehensive *Convolutional Neural Network (CNN)* for person re-identification and tracking in public areas with the aim of the full automation person re-identification system using multiple cameras. In our method, we grab the frames from the video sequence using an accurate multi-target tracker. Then, each frame is processed by a *Siamese* network architecture developed by using *Caffe Framework* to generate a feature vector consist of 1024 values representing the person's physical appearance. This architecture consists of two sub-networks with identical weights with. When the network gets two inputs, the sub-networks map those inputs to a pair of feature vectors. Then it compares two output vectors using *Euclidean distance*. During training, the *Siamese* network is shown similar and dissimilar input pairs. Features are extracted from the frame by frame using a *CNN* in our system. Here, we crop the person using the *Python image library* module as background reduction for accurate the results. Then, we combine information from all time-steps to give a comprehensive appearance feature for the outright sequence. The System achieves 55% accuracy using our Siamese network architecture.

Keywords: Re-Identification, Convolutional neural network, Siamese network architecture, Euclidean distance

Toxic Comment Classification Using Machine Learning

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Comment classification models are available today for "flagging" the comments. However, determining whether or not a comment should be "flagged" is difficult and time-consuming. Another major problem is the lack of sufficient data for training the model, and there are some issues with the available datasets because those are annotated by the human raters and those annotations are dependent on their personal beliefs. Lack of multi-label comment classification model causes for issues of abusive behavior. This paper presents models for multi-label text classification for identifying the different level of toxicity within a comment. In this paper, we use Wikipedia comments which have been labeled by human raters for toxic behavior provided by Kaggle. Comments have been categorized into six categories as toxic, severe-toxic, obscene, threat, insult, and identity-hate. The dataset contains 159572 comments. For data analyzing we use python seaborn library and python matploitlib library. It is understood that the dataset is highly skewed. Most of the comments do not belong to any of the six categories. Researchers used undersampling for majority class to correct the bias in the original dataset. We tested three models: a feed-forward neural network with Keras and word embedding, a Naive Bayes model with Scikit-Learn, and a LightGBM with 4-fold cross-validation. For the neural network, it took 3.5 hours to be trained on Nvidia GeForce 840M which is having 384 CUDA cores, Naive Bayes model with Scikit-Learn took 3 hours where LightGBM with k-fold took 4 hours. Researchersran 100 epochs from each model. At the end of 100 epoch, the neural network gave 0.9930 of validation accuracy and loss was just 0.2714, Naive Bayes model with Scikit-Learn gave 0.9556 validation accuracy and loss was 0.4121 where LightGBM with k-fold accuracy was 0.9000 and validation loss was 0.4263. The neural network gave the best accuracy at the end of the 100^{th} epoch.

Keywords: Comment classifications, Deep neural networks, Machine learning, Naive bayes, LightGBM, Keras, Scikit-Learn

A Game-Based Driving Learning System for Sri Lankan Driving Learners to Enrich the Awareness of Road Rules

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Traffic safety is becoming an important problem in most of the countries. Based on investigations it has been identified that the unawareness of road rules, lack of practice of sudden reactions in hazardous situations are the major causes for accidents. Though there are many driving simulators available, most of them have not addressed the road rules and hazardous incidences that a driver must be aware. Also they are lacking of a proper evaluation of the driving skills and awareness of the driver. Primary objective of the system is to provide a driving learning platform for the learners, trainers as well as evaluators to overcome the existing challenges, which has mainly focused on creating a virtual environment to facilitate the training and testing process in the local context and main areas of violating road rules and regulations by drivers are taken into account. In order to provide a realistic road environment, virtual environments are modeled based on different criteria. Artificial Intelligence techniques like non-player characters and objects, are employed. Through that, the responsiveness and intelligent behavior of the simulator has been improved. One of the major components of the simulator is the driver evaluation: a point based method defined upon the rules, road conditions and driving ethics established in the country. Further, the virtual environment provides all the road conditions available, countryside as well as the urban traffic conditions with different weather conditions. The effectiveness of the developed simulator is measured by allowing a selected group of learners to use the simulator for a specific period and assess their driving skills in a real driving environment. It can be concluded that training the learners in a virtual environment that similar to the real environment with a proper assessment of their driving skills, awareness of the rules and road signs, and the driving ethics will solve most of the problems we face today.

Keywords: Driving game, Simulator, Driving license, Road rules, Non-player characters

An Accurate Indoor Navigation Method Using Radio Signals and Machine Learning Techniques

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Navigation is the process of identifying positions of the passengers and then display feasible paths to guide them to their destinations. Global Positioning System (GPS) is suitable for outdoor navigation. Due to the lack of GPS signal reception inside buildings, new technologies should be emerged for navigating inside the buildings and covered areas. The main objective of this study is to propose an accurate and reliable schema to navigate passengers inside unfamiliar indoor environments along the shortest path to their destinations. The proposed navigation process consists of tracking the passenger, identifying shortest path and continuously guide passengers to their destinations on the fly. Triangulation technique is employed on Wi-Fi signals coming from at least three Wi-Fi routers to identify the position of the passenger. Wi-Fi routers are recognized using their MAC addresses and then triangulation algorithm is applied. Proximity algorithm is used together with triangulation algorithm to increase accuracy. The map of the indoor area is scaled via x and y axes and positions are identified as coordinates of it. The path to the destination is animated through these coordinates. Shortest path between current and destination location is calculated using Dijkstra's algorithm. Prototypical development is achieved by proofing the concept for feasibility of the proposed indoor navigation architecture. It can be concluded that, a significant accuracy can be achieved by using Wi-Fi technology, triangulation algorithm, proximity algorithm and Dijkstra's algorithm. Further improvements on accuracy of proposed indoor navigation architecture can be achieved by incorporating Radio Frequency Identification or Bluetooth beacons technologies together with Wi-Fi technology.

Keywords: GPS, Triangulation algorithm, Dijkstra's algorithm, Fingerprint algorithm, Indoor navigation, Bluetooth, RFID

Development of Non-Destructive Image Analysis Protocol to Assess the Quality of *In-Vitro* Propagated Orchid Plantlets

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In-vitro propagated plants are vulnerable to external changes leading poor growth performances depends on the vigour at hardening stage. The accurate procedure to evaluate *in-vitro* propagated plants, prior to hardening is vital through incorporating modern technologies such as image processing, to mitigate the drawbacks in visual evaluation which is used at present. Therefore, this study focuses on developing an image analysis protocol to assess the quality of *in-vitro* propagated Orchid plants. Digital photographs of the culture vessels of Orchid plants which were at the stage of acclimatization were taken inside an illuminated chamber. A visual scoring scale was developed in a scale of 0 to 5 to rank individual plantlets in each vessel. Plant images were isolated from the background and mean red (R), green (G) and blue (B) values were calculated from the segmented images. Through the RGB values, Yellowness, Hue (H), Saturation (S) and Intensity (I) values and thereby Dark Green Colour Index (DGCI) were calculated. Further vegetation indices such as Photosynthetic Vigour Ratio (PVR), Plant Pigment Ratio (PPR), Redness Index (RI), and Green Leaf Index (GLI) were also calculated. The visual evaluation score, DGCI, Yellowness and vegetation indices values were tested to determine the correlation between visual evaluation score and other values obtained using digital photographs. Among all indices, strong correlation ($p<0.05$) was observed in PVR and RI and then the composite of the values were accordingly regressed with visual evaluation score to select healthy and chlorotic tissues. The high possibility of the use of PVR and RI values composite (PR) to determine the quality of *in-viro* propagated plantlets, was determined by high R squared value. The function for the quality of the Orchid plants was developed using constant coefficient and coefficient of PR, obtained through regression that could easily apply to select the high quality plantlets.

Keywords: Image processing, Orchids, *In-vitro* propagated plantlets, Vegetation indices, Visual score

Concentration Device for Increasing Productivity Through the Improvement of Pomodoro Technique Using Colour Psychology

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Nowadays mobile devices play a considerable role in the technology revolution, and people have been especially addicted to the Social Medias through smart phones. One of the major challenges that people face today is time consumption due to this addiction on these activities in all day. Most of the time children are the major victims of this problem and they cannot keep the concentration on a particular work due to this addiction and this is a reason to reduce brain power as well as the memory losing. At present, some smartphone applications are used to solve the above problems. These applications are supposed to be developed to increase the concentration on work for a particular task to make it true. The major drawback of this mobile applications is losing the concentration, when other unnecessary notifications are appeared suddenly. Also the mind is impelling to use social media and other activities instead of doing current activity. There are several techniques for preserving the concentration such as yoga, build willpower etc. Among them highly recommend technique to increase concentration on work is called Pomodoro technique. Researchers have developed a device that help to retain the concentration on work by using this technique. This device contain RGB led, LED, small speaker and a push button. It is projecting spectrum colors, when the device in the deactivate mode. After pressing the button device follows that technique and make the user concentration on their work. Researchers have improved the technique from this device by using beep sounds and colour changes for each and every ten minutes of working. When worked time is completed device projecting spectrum colors using RGB led. Therefore, it is like a reward for the user. In the future, team members are focused on monitoring the user and make the device as an IOT device to store and get the reports with working statics.

Keywords: Pomodoro technique, Concentration, Colour psychology

Augmentative and Alternative Communication Application for Adults with Language Difficulties: An Application Developed in Sinhala Language

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Many adults can experience acquired disorders such as stroke, Parkinson, amyotrophic lateral sclerosis that can interfere with their ability to communicate with others. Currently, adult individuals who experience these kinds of difficulties need to rely on low-technology options such as printed out alphabet boards to express themselves. The number of words that a person used to communicate with others is much larger than the number of words printed on the boards, hence they face difficulties in communicating with the others. To address this issue, a text-based Augmentative & Alternative Communication system was developed in the Sinhala language for adult persons with speech disorders. The system comprises of three components keyboard layout for Sinhala fonts, next word prediction, and the text-to-speech converter. The methodology of the study was applied as follows. The requirements of the patients were collected from the Disability Rehabilitation Department at the Ragama Base Hospital. The requirements were analyzed case by case and a keyboard layout was designed by taking all the requirements into consideration. The most important module of this system is the next word predictor. This module assists a patient to predict the next word once he selects a word. The RNN neural network model was trained with a typical set of words that such a person often used. The word sequence was constructed from the requirements identified from the interviews with such patient and the health care professionals who have been working in this field for a significant period. A model was trained to perform text-to-speech using TensorFlow libraries. Once, the word predictor constructs the sentence, the whole sentence is converted into voice at once. The initial evaluation of the system was conducted only with patients who are being received treatments at the Ragama Hospital. The test results show that the system is able to communicate easily with patients in decent accuracy.

Keywords: Augmentative & alternative communication, Neural network, N-gram model, Android keyboard, Sinhala TTS

Modelling the Semantic Significance in Non-Factoid Question-Answer Pairs in Online Discussion Forums Based on Deep Belief Networks

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Modelling the semantic significance between questions and answering (QA) is essential for the detection of precise answers in Online Discussion Forums (ODF). QA can be divided as factoid and non-factoid. Traditional methods of modelling semantic relevancy lead to the sparsity of the word features due to the short texts in non-factoid QA pairs. Textual features and word co-occurrence features that commonly used in factoid answer quality predictions are irrelevant to ODF. Hence we are proposing a model to extract textual features in non-factoid QA pairs based on Deep Belief Network (DBN). DBN is modelling the semantic relationship between QA pairs by reconstructing QA pairs into a low dimensional semantic feature space. The DBN is capable of demonstrating the semantic relevance between QA pairs by modelling the semantic information hidden in the answers. Dimensions of the DBN feature space are minimized using word frequency and occurrence of function words as word features. The model is learning the semantic information from the solved question threads and then model is training to reconstruct the question using its answers. Cross entropy error function and gradient descent optimization algorithm are used to fine tune the weights of DBN. The candidate answers with the smallest distance computed by level by level calculation is considered as the best answer for the given question. Precision (P) and Mean Reciprocal Rank (MRR) methods are used to evaluate the performance of the DBN model over the Cosine Similarity, HowNet similarity and KL-divergence Model. Result shows HowNet is unable to calculate the semantic similarity between QA pairs with high precision. Compared to the cosine similarity, KL- divergence achieved more perfection. The DBN model showing a significant difference of 5.66% in P and 3.4% in MRR when applying fine tuning. The reason of growth in the DBN model is fine tuning and training the model to learn the semantic relevancy in QA pairs from the training set.

Keywords: Semantic significance, Non-factoid questions, Data belief networks, Online discussion forums

Distinguish Garnet Mineral from Pulmuddai Beach Sand Using Image Processing Techniques

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Beach sand is one of the major minerals producing source in Sri Lanka. *Pulmuddai* Beach, rich in Ilmenite, Rutile and Zircon and Garnet and it is the largest mineral processing plant in Sri Lanka. It's a great necessity to explore high mineral localities for production. In the industrial level, the percentage of a specific mineral is calculated using a visual inspection through a microscope which is manual and time-consuming. The research introduces an innovative method to distinguish *Garnet* mineral from sand using image processing techniques. In this study, 1125 visible light *RGB (Red, Green, Blue)* images and 1125 Infrared (*IR)* images of beach sand were captured in a controlled light environment. RGB color composite images and IR images were analyzed separately to identify *Garnet* mineral from the gang and to calculate *Garnet* percentage. For the *machine learning classification* purpose, *contrast, variance, mean, median, min, max, range, kurtosis, skewness, standard deviation* and *correlation* were extracted from sand grains images. Then *RGB, HSV (Hue, Saturation, Value)* and *RGBIR (Red, Green, Blue and Infrared) color models* were used through a *machine learning* model. The highest accuracy of 63% of separation accuracy was given by the *HSV* color model. The accuracy could be increased by introducing more images to the *machine learning* process. The final model was built based on the *HSV* color model since it has the high accuracy of separation. Then the *HSV* model subjected to *object counting model*, *area-based counting model* and *volume based counting model* to identify the most suitable method for the percentage calculations. Among these three methods, an *object counting model* produced the more accuracy results with 57%. Thus, the *HSV* color model incorporates with *object counting model* produces the best combination to identify Garnet and calculate its percentage.

Keywords: Image processing, Garnet mineral, Machine learning, Color model

Data Mining Approach for Landslide Prediction Using Support Vector Machine for Rathnapura District, Sri Lanka

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Haphazard development activities on mountain slopes and inadequate attention to construction aspects have led to the increase of landslide and consequently sustaining damages to lives and infrastructure. Nearly 3275 sq.km of area spread over the Rathnapura District, seems to be highly prone to land sliding and mass wasting of 2178 sq.km. Landslides occurred in many regions of Rathnapura district Eheliyagoda, Ayagama, Kalawana, and Nivithigala DS divisions, and nearly 90 deaths have reported according to National Research Building Organization (NBRO) 2017 records. Most landslides or potential failures could be predicted fairly and accurately if proper investigations were performed in time. The primary objective of this study is landslide-hazard mapping and risk evaluation to determine the real extent, timing, and severity of landslide processes in Rathnapura district, where such knowledge will provide the most significant benefit to government officials, consulting engineering firms, and the general public in avoiding the landslide hazard or in mitigating the losses. Data mining approach can be used to develop prediction models using existing data. Support Vector Machine (SVM) was selected for this study to possess a strong capability to predict landslides by causative factors, slope, land use, elevation, geology, Soil Materials and triggering factor; rainfall was extracted and applied to the SVM. This research introduces a methodology to produce a more relevant and accurate prediction of the landslide and identify the relationship between the hydrological characteristics, soil characteristics and the landslide vulnerability within the study area. Moreover, an improvement of the hazard monitoring, accuracy of early warning and disaster mitigation was performed. The SVM procedure was found that all of the factors had relatively positive effects on the landslide. Based on these results indicate that SVMs can be useful and practical for landslide susceptibility analysis.

Keywords: Landslide, Support Vector Machine (SVM), Hydrological, Land use, Rainfall

Developing Simple and Economical Prototype to Measure the Internal and External Quality Parameters On Poultry Eggs

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Egg quality is based on the characters of an egg that affect its acceptability to the consumer. There are several quality parameters used to identify the quality eggs; both internal and external. Internal quality refers to measuring the egg albumin and yolk distribution and yolk color whereas external quality refers to egg size, weight, shape and shell thickness. According to the quantitative and qualitative parameters there are different grading systems available for measuring quality and classify eggs with different groups and price levels. However, still there is no user friendly and economical method to measure the egg yolk color, shape, weight and shell thickness from a single machine. The study attempts to design a prototype to fill this gap. The egg weight is measured by using load cell which is connected to a liquid crystal display and to the computer. When the egg is placed on the cell the value is displayed both on the computer screen and display. The shell thickness is measured using a digital Vernier caliper. The value is displayed once it is placed between the two arms of the Vernier caliper, which is connected to the computer via an Arduino board. The yolk color and egg shape are measured using image processing techniques. In both processes an RGB image is taken and it is converted to a gray scale image. Then a histogram is developed using the pixel count of each point through length and width. Finally, by analyzing the histogram the output is given. The completed prototype was tested and accuracy was measured. Each feature of the model was accepted by more than 60% of accuracy. After all, a survey was done for testing the user acceptance with the participation of selected 20 poultry farmers, and that accuracy level was appreciated by more than 80% of respondents.

Keywords: Egg quality, Economical, Image processing

An Intelligent Predicting Approach Based Long Short-Term Memory Model Using Numerical and Textual Data: The Case of Colombo Stock Exchange

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The data forecasting provides a significant guidance for making decisions in many areas especially in stock market today. Due to extremely dynamic and complicated nature of stock markets, price prediction has become a cumbrous challenge. However, there are certain underlying determinants which have a strong influence on the stock market. There are experiments from various areas aiming to take on that challenge and Machine Learning have been the focus of many of them. Nevertheless, many studies used either numerical or textual information, but not both for a single approach. In the present study, a forecasting model was developed to predict the stock prices based on the historical data, investor's activities, macroeconomic variables and news articles. In the process of developing the model, number of factors influencing on stock prices were examined using the ordinary least squares method and technical indicators were identified by reviewing literature. The latest stock data and investor's activities were collected from data library, issued by Colombo Stock Exchange on daily basis for a period of seven years from 2011. Interest rates, exchange rates were used as macroeconomic variables, which were collected from the reports of Central Bank of Sri Lanka. News articles were extracted using a sentimental analysis by analyzing news extracts from most popular news websites. Finally, the prediction model was developed based on recurrent neural network (RNN) and multivariate Long Short-Term Memory (LSTM) approach to predict stock market. The performance of the proposed approach is demonstrated on real-world data of 12 companies listed on Colombo Stock Exchange. The prediction quality of the models is evaluated using MAE, MPE, MAPE, MSE and RMSE. The LSTM and recurrent neural network provided a decent accuracy. The project developed a multivariate prediction model by abolishing the limitation of underutilization of sentiments in price prediction.

Keywords: Stock market prediction, Recurrent Neural Networks (RNNs), Long Short-Term Memory Networks (LSTMs), Multivariate analysis, Sentiment analysis

A Genetic Algorithm Approach to the Integrated Inventory-Distribution Problem of a Retail Supply Chain of Perishables

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Managing retail supply chains of perishables is significantly complex due to the limited shelf life and the higher level of demand uncertainty at retail level. After conducting a comprehensive literature review, it is concluded that the consumer buying behavior for perishables at retail level is highly dependent on the freshness and the availability of the products on the display. The most highlighted fact in the literature about perishables in retailing is the importance of achieving a better service level at the lowest possible cost. Thus, the objective of the study was made threefold. Firstly, we formulate an integrated inventory – distribution problem of a three echelon retail supply chain as a Mixed Integer Non-linear programming model. The novelty of the proposed model is that we address demand uncertainty, freshness dependency of demand, display availability dependency of demand and the perishability simultaneously in the same formulation. Furthermore, we propose separate formulations for different issuing policies at both retail and distribution center levels. Secondly, the developed models are validated by solving small size instances of the problem using LINGO 17.0 Optimization software. Most of the real world scenarios involve multi – retailers, multi – distributors, multi – products with large instances which makes the proposed model NP-hard. Therefore, a genetic algorithm which achieves high quality near-optimal solutions in a reasonable time, is proposed to solve larger instances of the problem finally. The authors have elaborated the GA with numerical examples and compared the results. The outcome of the study proposes the GA approach as the best solution to reduce the total cost while providing a higher service level.

Keywords: Genetic algorithm, Integrated inventory-distribution problem, Perishables, retailing, Service level approach

Landmark Recognition using Image Processing and Machine Learning

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In the modern world, tourism has become one of the fastest growing industries. In every form of tourism, the tourists encounter landmarks, which they have no knowledge on them. The current way of identifying the landmarks is either to refer printed material such as books, magazines, which describe the important landmarks of the particular region, refer the Internet, or get the assistance from a tour guide. Referring printed material while traveling is not a practical solution in today's world. Referring the Internet may be practical, but after the landmark is accurately identified. Getting the assistance of a native person will involve financial costs and the source may be less reliable. As a solution to the above problems, we suggest a mobile application, which identifies landmarks using pictures and gives all relevant information, which would be useful for a tourist. The proposed solution uses image processing and machine learning to identify landmarks. A dataset of 5000 different landscapes is used in this project. The dataset was preprocessed using *Caffe deep learning framework* in order to remove unnecessary noise. One third of the dataset is randomly selected as the test set. The dataset was divided according to regions and models were trained for each region. *SVM* (Support vector machine), *BOW* (Bag of Words) and *CNN* (Convolutional Neural Network) algorithms were trained. The accuracy of the *CNN* model is 90%, while the accuracies of *SVM* and *BoW* are 70% and 60% respectively. Hence, the *CNN* model is used in this project. Dataset was divided according to regions and models were obtained for each region. Dividing the dataset into regions increased the accuracy and reduced the training time. The *GPS* data is used to identify the region and the appropriate model is used to retrieve the related information for the given landscape. The model was tested with real users and their positive feedback indicates the success of this project.

Keywords: Landmark recognition, Machine learning, Image processing, CNN

The Study on Undergraduate's Readiness to Adapt E-Learning Technology in Sri Lanka

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E-learning is a modern method of education delivered via digital types of data that improves the learner's understanding, abilities, or other performance. It is considered one of the critical alternatives for present knowledge based on society. Yet little researches have been done to verify the process of how undergraduates adapt and use E-Learning. The primary purpose of this study is to identify the extent of an undergraduate's readiness to adapt E-learning technology in Sri Lanka. The adaptation and the extent were discussed according to the Technology Acceptance Model (TAM). A self-administrated questionnaire with five points Likert scale used as a research instrument to gather information from 180 respondents. The researcher has used both SPSS statistics 21 and SmartPLS3 software packages to analyze the data. Further, in analysis researcher has been used the reliability analysis, descriptive analysis, correlation analysis and partial least square method. The study revealed that nearly all the respondents almost affect with the Perceived Ease of Use and the Perceived Usefulness to adapt E-learning technology. However, the respondents are moderately affected with the Behavioral Intention to adapt E-learning technology. According to the objective of the research, there is a significant positive association between all dimensions which are, Perceived Ease of Use, Perceived Usefulness and Behavioral Intention with E-learning adaptation intention. It can be clearly stated that the above-mentioned variables and the E-learning adaptation were directly proportional. Among the three dimensions of E-Learning adaptation, the Perceived Usefulness has the highest correlation coefficient. And there was a substantial impact of Perceived Ease of Use on Perceived Usefulness while Perceived Ease of Use had the least impact towards the Behavioral Intention. The study creates a number of recommendations for the undergraduates, universities and the learning institutions.

Keywords: E-Learning, Perceived ease of use, Perceived usefulness, Behavioral intention, E-learning adaptation intention

Effective C-RBAC Framework Based on Role Provisioning for Data Protection in Business Application Systems

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Security plays a key role in any business organization for the purpose of information sharing and privacy. However, there is a lack of privacy and safety among the information. Business data and organizational data are considered to be the highly sensitive data because of the impact that may result in the business process. The employees of any organization are the real assets for their concern and it's the responsibility of the organization should have a clear vision about the activity of all the employees under legal business development. In this article, new RBAC (Role Based Access Control) framework is developed to navigate the process for a particular employee and their services in any business organization. RBAC framework is especially developed to provide security based on role provisioning during information sharing. AgZKPk (Aggregate Zero Knowledge Proof knowledge) and OCBE (Oblivious Commitment Based Envelope) Protocols are used for role enrollment for RBAC concept (condition policies). In this paper, C-RBAC (Cloud– Role Based Access Control) framework is proposed which can fit in any business organization application. In this C-RBAC, PEP (Policy Enforcement Point) is used to avoid unwanted information sharing with the neighbouring employee or peers. The analysis is done based on the security level for several security algorithms in C-RBAC framework. C-RBAC framework with RSA provide well security based on number of employee with the data handled by the particular employee than the existing RBAC framework with AES (Asymmetric Encryption Standard) and RSA (Rivest–Shamir–Adleman) in terms of number of information they can handle per user. Our analysis revels few threats that arise due to sharing of data and violation in agreements. Also, it is inferred that by adopting our proposed framework, we can avoid data leaks and can protect the data even within the organization.

Keywords: Aggregate zero-knowledge proof knowledge, Oblivious commitment based Envelope, Policy enforcement point, Role based access control

E-Business Decision Support System for Online Shopping using MAS with Ontology and JADE Methodology

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E-Business systems are playing a crucial role in human's day to day life. It acts as an interface between the product manufacturer and the end users thereby reducing the time and cost. It also offers a variety of choices in products based on product ratings for quality, pricing, and services. The customers of the e-commerce ecosystem can do everything online and even make the payments. Recommender systems suggest/help the customer for shopping the products based on their interest and their usage. JADE (Java Agent Development Framework) is FIPA (Foundation for Intelligent Physical Agents), that enable automated agents to perform intelligent tasks efficiently. JADE is an open Framework with stable and optimal database agents in the distributed environment. MAS (Multi-Agent System) offers the methodologies for the financial transaction in an E-Business environment. The recent implementation of MAS with the current Web methodologies (JACK, JADE, etc.) serves as the building blocks for the upcoming e-commerce platforms for taking core decisions and negotiations. With the help of Agent-Oriented Programming Languages, the functionalities/roles in the use cases are created as Agents. Though this domain is growing exponentially, constructing an ontology for a dedicated purpose is a challenging task to define various concepts and actions. Thus, the e-business ecosystem invites fruitful research solutions for time-constrained applications and secure transactions. In this article, we propose a framework that combines the JADE, ontology and Multi-Agent System based web service composition to increase the efficiency of the system with optimal services. Also, our proposed system aims at providing a secure E-Payment under the availability of financial institutions. The proposed framework is tested under different cases and it is inferred that the system will offer an efficient process for the secured and time-saving E-Commerce transactions.

Keywords: JADE, Multi-Agent system, Online shopping, E-Payment, E-Business applications, Message exchange technique

Application of Image Processing and Neural Network Technique for Rice Grading

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When considering the agricultural industry, Rice is a principal food source in Asian countries. It is the most commonly and widely used grain in the local consumer market. Thus, analyzing the quality of rice is important. The quality of Rice will depend on the milling. Most mill owners do not have a proper method of measuring the quality of rice. Calculations are currently carried out using the Vernier Caliper in research centers, but it is a time-consuming task. Though there are some machines for automating this process, its usage is very low because of the high cost. Rice can primarily be classified based on colour and shape. Here we analyzed the two genres, *Red Kekulu* rice and *Samba* rice produced by *Bombuwala* rice research center. This paper introduces the rice classification method according to image processing approaches and neural network. Physical characteristics of the grain such as major and minor axis length, perimeter, area, colour and chalkiness are used to classify the rice grains. Identifying broken rice and wastages are the major objectives of the grading system. We have compared the proposed system results with manual measurements and visual observations. Matlab tool is used for image acquisition, preprocessing, segmentation, feature extraction and training the data set. This proposed grading system has scales such as premium, grade A, grade B and it was defined under supervision of rice researchers using broken rice and wastage content. The proposed image processing methods can reduce the time of operation and increase the accuracy. Finally, with the proposed grading system consumers will be able to receive information regarding the quality of the rice.

Keywords: Matlab, Neural network, Physical characteristics, Image processing, Grading system

A Machine Learning Approach for Emotion Classification of Sri Lankan Folk Melodies

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Music plays a vital role in our day-to-day life and considerably more in the current digital age. It can convey and evoke powerful emotions, owing to various musical characteristics such as rhythm, melody, and orchestration. This amazing ability has motivated the researchers worldwide to discover relationships between music and emotion. As a result, various data mining tasks have been carried out where state-of-the-art machine learning techniques are utilized in music emotion classification. However, the literature reveals that these studies frequently utilize western or western classical music. Since the emotional expression in music is carried out through various ensembles of musical characteristics which are cultural-specific, generalizability of classification models trained using different ground-truth data in a new context is problematic. This demands the development of emotion classifiers for cultural-specific music which are been less explored. As an example, no considerable effort is reported in computational modeling of Sri Lankan folk melodies, despite being an abundant source of emotion expression. Therefore, we propose a machine learning approach for their emotion classification, supported by a comparison among different standard classification algorithms, further identifying a set of acoustic features contributing for improved classification accuracy. A systematic literature review has been carried out which revealed the use of classical machine learning algorithms e.g., Artificial Neural Networks, Support Vector Machines and Bayesian networks, frequently employing timbral, rhythmic, and pitch features. In the proposed study, an emotion-annotated dataset comprising of 76 music stimuli (30s; 44100Hz; stereo; 32bit; .wav) is to be utilized with MATLAB MIRToolbox for acoustic feature extraction. It is believed that the findings of the study would mark a promising start, introducing machine learning for emotion analysis in Sri Lankan folk melodies.

Keywords: Music emotion classification, Machine learning, Sri Lankan folk melodies

Automated Collection of Customer Feedback Using Facial Expression and Machine Learning Techniques

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Today, feedback of customers is crucial for businesses and organizations. It is the main method of identifying the customer service, quality and future improvements of the service. Nowadays most of the modern companies are focusing on digitalized approaches to collect customer feedback where the users can instantly rate the service. In order to take the feedback from customers in a digitalized way, there are some machines and methods available such as happy-or-not feedback machine. Analyzing the feedback is the only way of measuring the performance of the customer service officers. But the main problem of these systems is that they only allow the users to rate the service manually and such that it allows to add expressions as they wish, rendering it unreliable. Also, there is no way to measure the customer service and employees' performance by computing. There are some methods to measure the customer service, such as crucial customer service metric. This metric can be used to measure the quality of the customer service. But, there is no automated and robust way to measure the customer service. This research introduces a device that applies the theories of the customer service metrics such as customer request volume, first response time, number of replies, customer satisfaction score etc. Machine Learning techniques are used to capture facial expressions and voice detection. The device facilitates measuring of customer service performance of employees autonomously by monitoring the employee involved in customer service and rates their results. The device captures the employees' expressions and apply the values into the customer service metrics and produces the overall performance. It can measure the real rating of the customer service without the need for customer interaction. This device could be beneficial in any field where customer satisfaction is crucial. The effectiveness of this device are yet to be obtained after being applied on a real world scenario.

Keywords: Feedback machine, Machine learning, Customer service metric, Facial expression recognition.

A Customizable Virtual Reality Application for Enhancement of Method of Loci

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The ability of memorizing more information can be considered as a measurement of intelligence, especially in the long-term memory. There are several ways to recall the memory such as mental memory tree, memory map, etc. These methods are based on the visualization of facts. The Loci method is one of the best methods which allows quick recall of information through visualization and the use of spatial memory. This method enables to memorize by linking information with various symbols. However, that method has been proven to be effective for centuries, it is still not widely adopted by most of the people due to the complications of understanding the technique. This difficulty of visualizing and usage of this method renders it less useful to a majority. Various studies on enhancement of method of loci have been done through the years. These studies are not providing customizable approach to the end-user. This research also enhances this application by enabling the end-users with the ability of customizing the solution making it applicable in a broad range. The solution introduced in this research is a Virtual Reality based software application developed using Unity3D Game Engine and Google Cardboard Virtual Reality Software Development Kit. It renders a memory palace along with the ability of customization allowing the user to store information along the palace path. The researchers have developed a mobile application which can be run on any device that supports Google Cardboard Virtual Reality. This application has the potential of aiding the user with the ability of memorizing various information with ease. This can be applied in a wide range of fields such as education and psychological treatment. The researchers have planned to further develop the application allowing users to use various mind palace templates according to their preferences.

Keywords: Virtual reality, Mind palace, Memory enhancement

Low Cost, User-Friendly, Integrated Shopping Cart System to Motivate Usage of Smart Shopping Carts in Retail Industries

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The main goal of retail industries today is to provide a comfortable shopping experience to their customers overcoming the traditional ways of doing shopping. This paper addresses an approach to this fact by implementing a low cost, user-friendly and integrated shopping cart which can be used in the retail industry to provide a better shopping experience for the customer. This system comprises an automated shopping cart, the smartphone which is used as the display device and a website. The system is best suitable for supermarkets where instead of customers having to wait in long queues to check out items, they can pay for the items at the cart using a debit or credit card. The website enables the customer to create shopping lists wherever they are and use it while shopping. The web interface attached to the cart shows the customer's current position, information of the product and the shortest path to the products and it was achieved by using the Dijkstra algorithm which was implemented using the Hipster Java Library. A model layout, similar to the shopping mall, was considered and measurements were taken of that. These measurements were broke down to similar points proportionate to the actual location points and by using the Dijkstra algorithm, the actual shopping cart locations were identified. The website is used by two main users, the admin and the customer. The admin can change the data on the website and data related to the android application. The customers can retrieve the information of the shopping mall. Indoor navigation of the cart was implemented using Bluetooth beacons. Coverage of three Bluetooth beacons was used to calculate the location. Through this research, low-cost methods to develop a smart shopping cart was identified and it was made user-friendly by implementing an easy to use website. This research can be helpful in identifying inexpensive and handy technologies to improve the usage of smart shopping carts in the retail industries.

Keywords: Shopping cart, Dijkstra algorithm, Bluetooth beacon, Smartphone, Hipster java library

A Cost Effective Method for Pavement Roughness Computation

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Pavement Roughness can be expressed as the anomalies in a pavement surface, which will affect the ride quality of a vehicle and the vehicle delay costs, fuel expenditure and tires and other expenses. Roughness can be expressed as International Roughness Index (IRI). Sri Lanka as a developing country lack of fund allocations has become a major issue for government authorities. Therefore, it is very important to have a proper database for proper planning of road networks. As the number of smartphone users is increasing, applications using smartphone sensors are also developing. In this research android applications were used to estimation of road roughness which can be used to collect road condition data cost effectively. Smartphones were attached to the front windshield of a test vehicle horizontally/landscape mode and standing vertically from road. Data collection was done by selecting the "Start/stop sampling" option in 'AndroSensor' and 'Roadroid' android applications by selecting video, photo or non –video mode with the defined route, maintaining 80km/hr speed. The study was done on 20 national roadway sections in Sri Lanka. The statistical analysis showed the percentage of similarity of the results of the measurement of evenness of pavement roads; between two smartphone application is 97.8% and linear regression model (R^2= 0.754) based on the relationship between estimated IRI values and existing IRI values evaluated using laser profiler which were obtained from Road Development Authority. Based on result from the experiment, smartphone application can be determined as an equipment that can be used to determine the surface roughness of pavements, as it provides data efficiently and with technical benefits.

Keywords: Smartphone sensors, Pavement roughness, Pavement condition, Android applications

Identification of Anomalous Clients' Request by Analyzing Server Log File using Apache Hadoop Framework and Tableau

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Information systems provide information about its state and operation in the form of log records. These records are composed of log entries containing information related to a specific event, which can be related to security. Potential security breaches can be revealed by analyzing log files and looking for anomalies that occurred at a certain time during the device operation. Log files from proxy server of Uva Wellassa University of Sri Lanka will be analyzed using Hadoop Framework and Apache Pig in order to identify anomalous clients' Request. Anomalous clients' request identification refers to the problem of finding pattern in data that do not conform to expected behavior. These non-conforming patterns are often referred to as anomalies, outliers or exceptions in different application domains. Log files of a proxy server are created and maintained by the server itself and analyzing theses files will offer a valuable insight into server usage while they can be used in various applications, such as detecting intrusions on the web. The log files will be stored in Hadoop Distributed File System. Data preprocessing and analyzation will be done using Apache Pig: a platform for analyzing large data sets. The analyzed data will be reported through Tableau dashboard. According to the research study, the total number of records after cleaning is 817,426 and 856 unique IP addresses have accessed the proxy server from the period of Thursday, 26 April 2018 01:14:48.138 to the period of Friday, 27 April 2018 10:31:23.834. Several findings including the total visits and bandwidth were found and displayed using graph and charts. This information along with other findings can be applied to find solutions for many legitimate problems such as, user/customer behavior analysis, etc.

Keywords: Proxy server, Log files, Apache hadoop, Apache pig, Tableau.

Exploring the Effectiveness of Search Engine Optimization Tactics for Dynamic Websites in Sri Lankan Context

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Visibility of a business, both in online and offline are important to grow businesses. In this modernizing digital era, businesses need to understand the significance of web presence in search engines through SEO strategies where it can make better ROI compared to traditional marketing. Therefore, than the international methodical SEO strategies, locally tactics have to optimize singly. The purpose of this study is to explore SEO tactics for dynamic websites in Sri Lankan context & evaluating its effectiveness than international SEO practices in terms of Google.lk. The main objective of this research is to investigate state-of-art SEO practices for dynamic websites to make search engines friendly with regards to rank it in Google search engines and examine which SEO optimization factors affecting the most. Further, the methodology of this study aimed to develop a conceptual framework to experiment the propositions. The mix approach used and survey questionnaire was distributed to 20 SEO experts out of 123 & 100 internet users from 2,400 who were supported to gather the experimental data for www.officestationery.lk. The research proceeded with simple random sampling technique and SPSS and MS Excel were used to analyze the data. Based on the SEO checklist it was implemented over the experimental website of www.officestationery.lk and proved that content optimization from on-page factors and backlinks from off-page factors are the underlying factors to rank in Google.lk. The findings of the literature review and the case study analysis indeed revealed to constructs and established the important factors out of all elements. This also revealed that there is no sense of keep relying on outdated SEO tactics as Meta tags or deep technical factors to rank in search engines. Therefore, for any dynamic website these primitive findings and recommendation approach are significantly important to be visible in Google.lk.

Keywords: Search engine optimization, On-page optimization, Off-page optimization, Dynamic website, Search engine, Google.lk

Determine a Software Usability Model to Improve User Experience in Generation Z Oriented Software Applications

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User Experience (UX) which focuses on having a deep understanding of users, their needs, their abilities, and their limitations, is one of the most important consideration when developing software applications today. Developing sustainable software application considering the main users of the application is the aim of any software company. Main users of software application are people who belong to workforce. New addition to the workforce is Generation Z and it will continue in the future. Therefore, it is important to pay extra attention to increase usability of software for generation Z who are exposed to digital technologies from their early age which may lead them to have different characteristics, expectations as digital natives than previous generations. Moreover, the literature indicates that they have emotional connection with digital world, more trust in digital sources and high regards for experience and pleasure it gives. In this research generation Z's software usability issues and their expectation towards software applications were identified through literature review and surveys conducted via questionnaires and interviews with generation Z software users, software developers and UX engineers. To address all these requirements, the features which should be incorporated were proposed as the last step and they were validated by software engineers and user experience engineers. Based on the findings, a new model was determined by identifying specific usability challenges in generation Z to improve software usability. Moreover, this study has come up with feasible technologies, approaches that can be incorporated when developing software applications for generation Z.

Keywords: User experience, Usability, Generation Z.

Lightweight and Portable Cross-Platform Application Development Framework

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Cross-platform application development is extremely useful among software developing organizations because large end-user audience can be targeted. Earlier there were several approaches, but they had drawbacks of each like complexity of design, low level accessibility and slowness of learning rate. Later, cross-platform application development with web technologies were introduced. Electron and NW.js are the most popular frameworks. Those combine embedded chromium browser and node runtime. Community pointed out several unseen drawbacks of these frameworks. Large bundled application size, high memory consumption and development workflow are the key things which were criticized through internet forums. Possible solution is that introducing a new cross-platform application development framework which is having all the advantages of Electron and NW.js but which is lightweight and portable. Importantly each platform has built-in browser component which can be used instead embedded chromium. Windows has MSHTML and Linux has gtk-webkit2. Furthermore, there is a default web browser in each platform too. Therefore, chromium module can be replaced with either user's web browser or web browser component. Node runtime can be replaced with a lightweight web server. This research introduces a new framework architecture which delivers implementation of portable, lightweight cross-platform application development framework including the proof of using top frontend frameworks. The new framework uses browser component or user's browser instead of embedded chromium and it will replace node runtime by introducing a lightweight server runtime which exposes required OS level functions. Application development kit consists of launchers per each platform, a HTML interface and source files (Javascript and CSS). Key highlighted advantages of new framework architecture design are light-weightedness, fully portability, less resource consumption and easiness of development workflow.

Keywords: Cross-Platform development, Application framework, Web server, Hybrid applications

Design and Develop an E-Kanban System Based on Lean Manufacturing Concepts to Optimize Supply Chain Management in Apparel Industry in Sri Lanka.

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Apparel sector, a fast-growing industry uses several Lean manufacturing concepts. Kanban, is considered as a popular method which is used to reduce unnecessary costs and wastage of the production process. It is an efficient method of managing supply chain process in apparels. Most of the factories do not utilize the technology and advancement in technology to the fullest potential in material handling although many factories follow manual Kanban and Lean manufacturing concepts. This research was conducted with the intention of designing and developing an e- kanban system. As a results of obtained from a statistical survey, background study and interviews, 87.5% expected to modify the existing system. Accordingly, Kanban system was converted into Electronic kanban system (E-kanban) using Radio-Frequency Identification (RFID) technology. Arduino mega, RFID module and RFID tags were used to design the system. To input data to the system, the C# interface was used. Then the number of Kanban to write data to the RFID tags were automatically calculated. RFID tags use filtering to prevent repetition. When the material is moving with the RFID tags in the line, the overall progress in the production process could be easily viewed. The research considers about the economic aspects as it proposes material saving through reducing paperwork and other printing materials. As this system pre-defines all the optimum things to be done, it is expected to reduce the workload and the stress levels of the employees. E-kanban system is strongly recommended in terms of its environmental friendliness. Finally, the concept was tested for user acceptance by conducting a simple survey and interviews. Each feature of the model was accepted by 86.7% of the respondents. Thus, it can be concluded that the system can be used for predictive analysis on decision making with manual and traditional lean concepts.

Keywords: Kanban, E-kanban, RFID, Supply chain management, Lean manufacturing concept

K-Means Clustering Algorithm to Predict the Badulla Tomato Price Based on Weather Factors

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Tomato is one of the most important cash crops in Sri Lanka and tomato is cultivating in several areas of the country. Among them, tomato farming in Badulla significantly contributes to the total local tomato production. However, the producer price of Badulla tomato is subjected to the fluctuation within a short period of time. Hence, farmers face great difficulties when selling their products. This study was aimed to explore the influence of weather factors on Badulla tomato price fluctuation. The data was collected from the Meteorological Department of Sri Lanka and the Hector Kobbekaduwa Agrarian and Research Institute for the past 10 years (2005-2015). These are the considered Badulla district weather factors: rainfall (BR), minimum (MinTB)/maximum (MxTB) temperature, minimum (MinRH)/maximum (MxRH) relative humidity and the farm gate price of tomato at Badulla district (BTP). The Data set was consisted only quantitative data and there were 574 instances. Analysis and investigation were done using data mining techniques. After preprocessing of data, 66% percentage from the total number of instances were considered as training data. The K-Means algorithm was used to cluster the above data vectors. The Euclidean distance function was used to compare the data vectors. The strength of K-Means clustering was validated using Elbow cluster validation technique. Five clusters were formed as the best number of clusters. Within cluster sum of squared errors: 24.68 and 15 number of iterations were performed within the clustering model. Highest Badulla tomato price centroid value was: Rs.49, other cluster centroid values were BR: 27.6mm, MxTB: 27.6 o C, MinTB: 14.2 o C, MxRH: 96.06%, MinRH: 63.1% of that cluster. As results of this research, it is possible to predict best weather conditions which are giving highest Badulla Tomato Price. That will be helpful for farmers as well as the decision makers to take correct decisions related to tomato farming.

Keyword: Clustering, K-mean, Producer price, Tomato, Weather

Smart Tour Planner for Sri Lanka

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Tourism industry is an asset to Sri Lankan economy. It contributes around 5% in national revenue. The development of tourism industry is significantly slow as compared to the other tourist countries because we are not using new technologies in this field. In recent years, several applications are developed for the tourism industry. However, those applications are only used to provide the information about the places. The most important thing when it comes to going for a tour is to manage the time. Moreover, managing time at an unknown place is very difficult. Climatic changes also affect the tourists to visit some places. To overcome these issues, we have proposed an Android based mobile application that can help tourists to plan their tour to Sri Lanka before arriving here. The application covers 5 major areas with the methodology. 1) Finding the shortest route using "Nearest Neighbor algorithm" that covers the as many as possible places to visit with respect to the tourist's budget, time and tour type. 2) An intelligent system that records the time spend at a place, then by using machine learning algorithms using Google's "TensorFlow" that can predict the time needed to visit that particular place for new tourists. 3) A schedule for tourists that they have to follow during their tour that helps to manage time. 4) Alerting the tourists for any emergency situations (flood, tsunami, Land sliding) using crowdsourcing. 5) Comment summarization and sentiment analysis that can give a brief idea about the places those tourists are planning to visit. At last, user gets a scheduled tour that he can follow up during visit to Sri Lanka. The evaluation of this application depends upon the time and money saved due to scheduling of the tour, and that saved time is use to visit some more places. This application helps the tourists to plan their tour easily that significantly increase the tourism in the country and will positively affects the country's economy.

Keywords: Smart tour planner, Tour scheduler, Sri Lanka tourism, Sri Lanka travel, Android application for travel

Developing a Lead Generation Mechanism to Identify People's Contact Points Using Web Data Analytics

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With the popularity of Internet & social media, the volume of data which is being shared through the web has been increased. As a result of that, various paths have been opened to conduct research studies in the area of data science & data mining. Developing a proper mechanism after doing a thorough analysis of web data to identify people's contact points will be an interesting research study since in this era, people usually tend to keep their digital foot print in the world wide web either by purposely or mistakenly. In this research, a mechanism for lead generation has been introduced by mining & analyzing publicly & freely available web data. Based on some given search criteria, using data extraction through web crawling techniques combining with Named Entity Recognition (NER) algorithms persons' names were identified at the first stage. Afterwards by performing an in depth search of the web, people's contact points such as telephone details, email addresses, occupations, interested areas were collected & then analyzed them by applying big data analytics techniques together with data mining to find the high accuracy data. In this process any kind of privacy violation is not happening since this mechanism is only using publicly available data. The final outcome contains very useful data set to many parties specially for financing & marketing industries since they can have an accurate target audience to perform their promotional activities. Not only that but also this research is beneficial for any person since they can have well oriented data regarding the criteria that they want to look at.

Keywords: Big Data, Web Data Mining, Web Crawling

An Ontological Study on Diabetes Sri lanka

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Diabetes mellitus is one of the serious diseases with a high risk spread across Sri Lanka society. Diabetes occurs when the body cannot produce insulin or at a consequences where body cannot effectively use the insulin, there are three types of diabetes exists namely Type I diabetes characterized by deficiency of producing insulin, the type I diabetes is known as an preventable disease, Type II diabetes is characterized by inefficient usage of insulin and it is the type of diabetes that the majority of people around the world suffering from. Gestational diabetes is occurring during the period of pregnancy and it can be diagnosed by prenatal screening. A set of competency questions were designed to decide up to which extend the users can get answered their questions using the ontology. By analyzing the data gathered from experts we identified some top classes and the subclasses of those top classes to be included in the ontology they are Person, Diabetes Types, Complications, Symptoms, Exercises, Dietary patterns, Sleeping Patterns, Family History and Working styles. The hierarchy of the ontology has been developed using subclasses and defining rules and constraints of the classes and sub classes, then the data properties and object properties were defined on classes to develop the hierarchy of the ontology. Constraints were used to verify the correctness of relationships in the ontology. Individuals were added to the classes using the existing knowledge. The tool we used to develop the ontology was Protégé 5.2.0. It is an Integrated Development Environment use to build intelligent systems. Extracting knowledge is the final outcome of an ontology, to extract knowledge from the ontology that we developed we use SPARQL which use to retrieve and manipulate the data stored in Resource Development Framework format. Natural Language processing was used as the approach to convert natural language into SPARQL and SPARQL into natural language to make it more user friendly.

Keywords: Protégé, Ontology, SPARQL, Rules, Diabetes, NLP

Mobile Apps' Feature Extraction Based On User Reviews Using Machine Learning

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The star rating and user reviews of Google Play store play a major role in App Store Optimization. The average number of stars received for an app and the user reviews are used to evaluate the overall app quality. We argue that the star rating is not a reliable measurement for the user satisfaction, since the star rating is a straightforward mathematical expression only. We cannot find a user's real experience about the app by asking them to rate the app out of five stars, even rating user reviews will give only an overall user perspective about the app. Therefore, we recommend a specific app feature evaluation method based on user reviews, which give us a genuine app rating than the conventional method. In addition to review based rating we did popular feature extraction from user reviews. Initially we started our research with mining user reviews from Google Play Store for several categories by using Web Scraping tool. We used the sentiment analysis to extract the meaning from the reviews and define the polarity of them. According to the polarity strength we rated each reviews. Overall rating was calculated by finding the average of given review based ratings. Then we compared review based ratings with the existing star ratings. We found that compare to overall review ratings, the existing star ratings differs and high. Moreover, the app feature set was selected according to the category of the app, and then the popularity of those features was calculated by using machine learning. We were resulted with app features and their popularity based on users' reviews. These popularities can be helpful to the potential app users to get know the top features and their popularity of the particular apps. In the meantime, app developers can identify which features have low popularity and they can improve those features in future.

Keywords: Reviews, Feature extraction, Rating, Sentiment analysis, Machine learning

Entrepreneurial Agriculture

- Agricultural Economics and Agri-Business Management
- Applied Economics and Statistics
- Economics and Econometrics

Modified Ridge Type Estimator in Multiple Linear Regression Model

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Instead of using the Ordinary Least Square Estimator (OLSE), the biased estimators are considered in the multiple linear regression model in the presence of multicollinearity. Some of these are Ridge Estimator (RE), Liu Estimator (LE) and Modified Almost Unbiased Liu Estimator (MAULE). An alternative method for solving the multicollinearity problem is to incorporate the prior information which is available in the form of exact restrictions with sample information. The Restricted Least Square Estimator (RLSE) is proposed by using sample and exact prior information. In the literature, the Restricted Liu Estimator (RLE) is proposed by replacing RLSE instead of OLSE in the LE. Since the combination of two different estimators might inherit the advantages of both estimators, we propose the new estimator named as New Ridge Type Estimator by combining MAULE and RLSE. The stochastic properties of the proposed estimator are obtained. Moreover, the performance of the proposed estimator over the OLSE, RE, MAULE and RLSE in terms of the Scalar Mean Squared Error criterion is investigated by performing a Monte Carlo simulation with the different degrees of collinearity. Furthermore, numerical example is used to evaluate its performance. Based on the simulation study, it has been noticed that the proposed estimator is superior to other existing estimator for some values of shrinkage parameter and different degrees of collinearity. Similarly, it is examined that the proposed estimator is superior to OLSE. According to the numerical example, it can be concluded that the proposed estimator is superior to some other existing estimator for some values of shrinkage parameter. Finally, it can be concluded that proposed estimator is meaningful in practice for the multicollinearity data.

Keywords: Biased estimator, Multicollinearity, Ordinary least square estimator, Prior information, Scalar mean squared error

Supplier Relationship Quality of Raw Milk Procurement in Monaragala District with Reference to a Dairy Company

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Dairy sector has a high potential to contribute for economy as a major subsector of livestock composed with Sri Lankan agriculture. Relationships among stakeholders in dairy supply chain are required to continue it effectively and raw milk procurement is the initial step. Relationship in between dairy farmer and processor (dairy processing company) which comprises of three aspects of satisfaction, trust and commitment crucially influences for the step. Therefore, the study was conducted to assess the quality of supplier relationship of raw milk procurement in Moneragala district, by analyzing determinants of quality of relationship, farmers' attitude on the effectiveness of farmer societies managed by processor and constraints of the raw milk procurement. A field survey was conducted for data collection using pre-tested questionnaire from randomly selected 98 dairy farmers. Descriptive statistics, principal component analysis, linear regression and Garrett ranking method were used in data analysis. According to the result, farmer reliability & satisfaction on price, farmer orientation, management image, attitudes on locality, equity of the company, satisfaction about communication & services, using fixed price girds and long term expectation of the farmers were extracted as determinants. Farmer orientation was an imperative determinant. Dairy farmers believed that, even farmer societies are unable to offer farmers' requirements sufficiently to develop their dairy production, they are more beneficial and effective tool to empower livelihood. Furthermore, low farm gate price, high cost of the feed, lack of finance to purchase and maintain high yielding breeds and low attention due to small scale dairy farming were identified as the major constraints. Thus, processor should built and maintain higher quality of supplier relationship as a companion by helping the farmers to overcome their constraints.

Keywords: Dairy farmers, Milk procurement, Moneragala district, Sri Lanka, Supplier relationship quality

A Study on Knowledge Level and Entrepreneurship Traits among Dairy Cattle Farmers

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Entrepreneurship is the dynamic process of creating incremental wealth. The wealth is created by individuals who assume the major risks in terms of equity, time and/or career commitment or provide value for some product or service. The product or service may or may not be new or unique, but value must somehow be infused by the entrepreneur by receiving and locating the necessary skills and resources efficiently and effectively. India is the largest milk producer in the world, therefore role of dairy farmers is very important in dairy industry and socio-economic development of the society. A study was conducted in Salem district of Tamilnadu, India to know the level of entrepreneurial behavior of dairy cattle farmers. A sample of 150 respondents was selected for present study. Majority of the respondents possessed different level of farming. Entrepreneurial behavior was positively and significantly related with education of the respondent, assess the pattern of entrepreneurship cattle farming, knowledge level traits, and pattern of entrepreneurship. The objectives of the study are, to analyze knowledge level of cattle farmers to improve dairy cattle farming practices and to find the common traits among the cattle farmers in the study area. The snowball sampling method was employed and the data were collected from the target respondents. Along with percentage analysis, Exploratory Factor Analysis tool was used to identify the major contributing factors. Four major dimensions were extracted from the total 29 variables studied namely, **"**cattle selection knowledge, cattle feeding traits, Distribution level of fodder supply to cattle and Common knowledge to identify periodical test". This resulted into four correlated factors, constituting several aspects of 'knowledge' 'Traits'. It turned out that the measurements of the four target structures loaded on different factors, which could indicate that different kinds of knowledge are needed for these structures; cattle selection knowledge, cattle feeding traits, distribution level of fodder supply to cattle and common knowledge to identify periodical test. This can be important among dairy cattle farmers.

Keywords: Cattle Selection knowledge level, Predict the health issues, Traits of dairy cattle farmer

Production Relationship of Shrimp Cultivation in North Western Sri Lanka Using Farm Level Data

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Shrimp farming offers considerable potential for diversification and income security in Sri Lanka's rural area. However, shrimp production has declined significantly in recent years due to unsustainable practices, and devastating epidemics. In terms of production volume and technology, the Sri Lankan aquaculture sector is still in an infant stage compared to other Asian countries. International trade in aquaculture products is one way of promoting economic growth and reducing poverty in most developing countries. However, aquaculture is under constant pressure from environmentalists and government regulation. Hence, this paper uses cross sectional data collected from 81 shrimp farms in September to analyze the production relationships in shrimp using farm level input and output data and to assess the potential gains of farmers by increasing farm size. A Cobb-Douglas production function was estimated to obtain the relationship between inputs and output in shrimp production. Shrimp farming observed a positive relationship between output and the inputs considered. The output elasticities are low indicating inelastic relationship between inputs and output. The major finding of the study is that shrimp farming in the Northwestern Sri Lanka has a constant return to scale implying the sectors' inability to obtain the benefits of economies of scale.

Keywords: Farm size, Production, Returns to scale, Shrimp

Impacts of Green Brand Benefits on Retailer Brand Loyalty

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With the increase of consumers' knowledge and awareness on the environment, sustainable or green marketing has been receiving much attention. Among different actors in the marketing platform, it is observable that modern trade retailers or supermarkets are now initiating sustainability or green practices which lead customers to see them as sustainability promoters. Thus, this study focused on identifying the consumers' impression on the greenness of a selected modern trade retailer in Sri Lanka, namely, Keells, who is currently practicing certain green initiatives. The study concerned the green brand loyalty of the retailer in terms of functional (utilitarian) and emotional (self-expressive) green brand benefits received by the customers and their impacts on green brand loyalty via green brand image. Further, the effects of environmental concern and consumer socio-economic factors on green brand loyalty were studied. The questionnaire survey technique was used to collect data from 200 customers who visited five selected retail outlets in the Colombo district. Measuring of the items was done based on Net Promoter Score (NPS) and multiple linear regression was used for data analysis. The findings showed that green brand loyalty is positively affected by green brand benefits via green brand image. Although both utilitarian benefits and self-expressive benefits have a positive impact, green brand loyalty and green brand image was highly enhanced by utilitarian benefits. Even though there was no substantial impact of environmental concern on green brand loyalty, with the increase of consumers' environmental concern it enhances the green brand loyalty for the modern trade retailer. Further findings indicated that the socio-economic factors do not indicate a significant effect on green brand loyalty. However, the consumers have identified the brand as an eco-friendly one with brand's functional and emotional oriented sustainability initiatives.

Keywords: Green brand benefits, Green brand image, Green brand loyalty, Modern trade retailer, Sustainability

Determinants of Rural Poverty in Sri Lanka

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Reducing poverty is a major issue for Sri Lanka as many developing countries. Poverty can be defined as a household's inability to access wealth resources that are sufficient to provide for basic needs. The causes of poverty and their timely behavior are more important to understand the seriousness of the problem in a certain sector in a country. However, the existing data and information on the causes of poverty in household level are lacking in the context of Sri Lanka. Thus, using Household Income Expenditure Survey data (2009/2010) of Department of Census and Statistics, this study attempts to find the determinants of poverty in rural households by estimating Probit Regression model. The study shows that poverty status is strongly associated with the level of education of household members, household size and presence of local migrants in the family. More specifically, education level reduces the rural poverty whereas having local migrants in the household increase the poverty.

Keywords: Households, Probit regression, Rural poverty, Sri Lanka

Spatial and Temporal Variation in Input Oriented Technical Efficiency of Paddy Cultivation in Sri Lanka

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Around 2.7 million tons of rice is produced in the country annually which is sufficient to fulfill 95 per cent of the domestic rice requirement. Demand for rice is projected to increase 1.1 per cent per year (Department of Agriculture, 2018). To meet this demand, rice production must grow at a rate of 2.9 per cent per year (Department of Agriculture, 2018). In order to achieve this production target, national average yield should increase. Introduction of inorganic fertilizer, pesticide and weedicide were useful to increase agricultural productivity. However, intensive use of these inputs causes severe environmental problems like pollution, biodiversity loss and changes in the ecosystem. Many claims that inputs in paddy cultivation are over used. Thus, the objective of this study is to disaggregate input over usage in Sri Lanka spatially and temporally. Panel data collected from costs of cultivation publications from 2000 Yala to 2016/2017 Maha were used. Input oriented technical inefficiency was calculated for 13 paddy cultivating districts in Sri Lanka using Stochastic Frontier approach. Cobb - Douglas functional form was selected to express the production relationship. According to the results, hypothesis about time varying nature of inefficiency was rejected. This shows that there's no temporal variation in input oriented technical inefficiency. Estimated input orientated technical inefficiency values shows that, there's a spatial variation in input over usage in paddy cultivation. Highest input over usage (72%) was in Batticoloa district while the lowest is (6%) in Mannar. Mean input oriented technical inefficiency of all 13 districts was 37 per cent relative to the most efficient paddy cultivating district in the data set. On average, input oriented technical efficiency of these areas should improve by 37 per cent to reach full efficiency. Curbing this overuse is important because, it not only increase cost of production but also damages environment as well. Field extension activities should develop to encourage farmers to use inputs in optimum amounts. How ever further research should be done to find out reasons for inefficiency in these areas.

Keywords: Input oriented technical inefficiency, Panel data, Stochastic frontier

Multidimensional Poverty in the Estate Sector of Badulla District in Sri Lanka

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According to the official poverty estimates of the Department of Census and Statistics, poverty in the estate sector of Sri Lanka has gradually reduced in monetary terms over the past years. However, in measuring poverty, monetary approach itself does not contemplate the extent of simultaneous deprivations suffered by individuals under multiple dimensions which are important for reduction of poverty. Therefore, this study aimed at estimating the level of multiple deprivation among the estate poor, identifying the dimensions that people are mostly deprived of and suggesting policies for alleviating poverty which leads to sustainable development of the country. To understand poverty in multidimensional nature, data from a convenience sample of 200 households in the estate sector of Badulla district was collected and analysed using Multidimensional Poverty Index introduced by Alkire and Santos (2010). The study reveals that Multidimensional Poverty Index for the estate sector of Badulla district is 0.12 and 34% of the population were multidimensionally poor along with 37.7% on average intensity of deprivation which are significantly higher than the estimated monetary poverty figures. Poor living standards and insufficient nutrition of estate sector people contributed significantly for multidimensional poverty in the study area. Sanitation which is a necessity of an individual was found contributing 4.8% which revealed their severity in poverty. However, the attendance of school by school aged children was satisfactory compared to the completed years of schooling by the rest of the household members. As plantation community is constricted within the estate areas, they encounter numerous deprivations and income is not always an ideal measure to determine the depth of poverty. Thus, it is required to reduce nutritional, sanitary, housing and household utility deprivations to reduce multidimensional poverty among the estate population in the Badulla district.

Keywords: Multidimensional poverty, Deprivations, Estate sector, Sri Lanka

Time Series Modelling of Monthly Rainfall in Kilinochchi District, Sri Lanka

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The amount of rainfall received over an area is an important factor in assessing availability of water to meet various demands for agriculture, industry and irrigation. Kilinochchi is one of districts in Sri Lanka and many people in Kilinochchi district are below the poverty line and mainly depend on the agriculture for their daily life. Rainfall is the main source of watering for agriculture in Kilinochchi. Forecasting rainfall in Kilinochchi district plays an important role in the planning and management of agriculture scheme and management of water resource systems. Therefore, it is essential to develop a time series model to analyze the amount of rainfall in Kilinochchi district. The main goal of this study is to find a suitable Auto Regressive Integrated Moving Average (ARIMA) model to the monthly rainfall data of Kilinochchi district. In this study, the monthly rainfall of Kilinochchi district under three different stations such as Iranamadu, Akkarayankulam, Kariyalanagapaduwan is modelled by using Box-Jenkins' time series approach. The monthly rainfall data under three different stations in Kilinochchi district was obtained from the department of meteorology, Sri Lanka during the period of January, 1986 to December, 2015. Further, three statistical criteria such as Akaike information criteria, Bayesian information criteria, mean squared error were used in order to select best the time series model. Through the modelling, it was found that Seasonal Auto Regressive Integrated Moving Average: SARIMA (0,1,1) (0,1,3)12 is the best fitting model for all three stations in Kilinochchi district. Moreover, the adequacy of the fitted best model has been tested using Ljung- Box chi-squared statistic. The identified best model can be used to forecast the monthly rainfall of Kilinochchi district in near future.

Keywords: Box-Jenkins Approach, Ljung- Box chi-squared statistic, Rainfall, Seasonal auto regressive integrated moving average

The Contribution of Urban Agriculture for the Urban Household Incomes in Kandy District

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There is a high potential to apply urban agriculture in Sri Lanka to earn additional income for households as it is gradually popularizing in the country at present. This study aimed to analyze the role of urban agriculture in the urban household incomes. Objectives of the study were to identify the benefits of urban agriculture, to evaluate the perception of urban growers towards urban agriculture, to determine the profitability and contribution of urban agriculture to total household incomes while identifying the constraints faced by urban growers. Kandy district was selected as the study area taking a sample of 100 urban households using the procedure of convenience sampling. A questionnaire was administered to collect the data. Descriptive statistics, Wilcoxon signed-ranked test and gross margin analysis were used as the analytical tools. The findings of the study revealed that, there is a positive perception towards the urban agriculture. Further, it revealed that the highest and the lowest gross margins were observed in Anthurium (*Anthurium andraeanum*) and Ambarella (*Spondias pinnata*) respectively. The study also found that urban agriculture has contributed about 1.63% on average to the total household income of the urban sector. Off farm engagements contributed about 85.4% to the household income of the urban sector followed by business and other sources such as transfer payments about 12.05% and 0.87% respectively on average. Inadequate land to cultivate, time constraints, high cost of irrigation and pest attacks were identified as constraints that urban growers faced. However, at present urban agriculture is not practiced well at household level and the study revealed the need to enhance the awareness regarding the potentials and benefits of urban agriculture.

Keywords: Benefits of urban agriculture, Constraints of urban agriculture, Grower's perception, Household income, Urban agriculture

Constraints for Popularization of Fresh Milk: A Case Study in Gampaha District

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Although fresh milk is considered a widely consumed beverage in the world, the level of milk consumption in Sri Lanka is considerably low with the per capita consumption of about 15kg per year. Today, powdered milk has acquired the biggest share of the local market and the demand for local milk has gone down dramatically. This has caused a large foreign exchange out flow from the country. In 2017, import expenditure of milk powder has increased notably by 27.6 per cent to US dollars 294 million. Hence, the present study was undertaken in order to identify the constraints for popularization of fresh milk and to find out the remedial measures to solve those problems. The study was conducted in Gampaha district, which represents the second highest monthly household expenditure on milk powder (LKR 1277.00). A pretested structured questionnaire based survey was conducted with a sample of 80 randomly selected households. The study revealed that the highest consumption was imported powdered milk brands (30%) mainly due to the high availability. There is a significant positive relationship between household monthly income and expenditure on fresh milk. According to the Kruscal – Wallis analysis, low availability was the main constraint for popularization of fresh milk from the consumer's point of view while second and third constraints were high price and low satisfaction about hygiene respectively. Lack of promotional activities was the prominent constraint for popularization of fresh milk at selling level. The study suggests it is vital to establish milk distribution network with sales outlets across the area and distribution by mobile vehicles to the doorstep in order to ensure the availability. Further, a media campaign could be launched to promote fresh milk drinking culture and discourage milk powder consumption.

Keywords: Constraints, Fresh milk, Popularization, Powdered milk

Willingness to Pay for "Fortified Compost": A Study on Vegetable Farming in Nuwara-Eliya District

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Urban waste mismanagement, soil fertility reduction in agricultural lands and the increasing world price of chemical fertilizer are the main problems that should be addressed immediately in the Sri Lankan context. A fortified compost consists of a mixture of municipal solid waste and faecal sludge which may help to reduce these problems to some extent. As this is a new product, distinguishing proof of purchaser inclinations is vital in outlining product with the most extreme buyer request to capture the market share. Thus, this investigation assessed buyers' expressed inclinations for fortified compost attributes through conjoint analysis. Ranked information was investigated utilizing Rank Ordered Logistic Regression (ROLOGIT) model. Also, ordinal psychometric measurement of attributes in fortified compost product was done through a five-point Likert scale. This survey focuses on vegetable farmers because the market for compost products is easy to implement in such a cluster. Through the multiple stage sampling method Nuwara-Eliya district was selected as it represents the highest number of vegetable farmers in the country. Face to face interviews was conducted among 300 randomly selected respondents representing all 5 DS divisions in the district. The results of ROLOGIT revealed that all four attributes (form of compost, distribution method, availability of faecal sludge and price per kg) have demonstrated a significant effect on choosing a compost product. For the form of compost; respondents were willing to pay an additional sum of LKR 4.18 if the product is in 'dust' form rather than in 'pellet' form. Also, 1.49 of marginal willingness to pay (MWTP) acquired for on-farm gate distribution strategy. Contrary to the expectation, farmers show a very high MWTP for the attribute 'presence of faecal sludge' with an additional amount of LKR 5.06. According to the Likert scale analysis close to 60.67 % of the respondents are willing to purchase the product in the next season. Hence, results of this study can be used to define a strategy regarding urban waste management with the combination of compost production.

Keywords: Conjoint analysis, Farmer preference, Fortified compost, Marginal willingness-to-pay

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Paddy Farmers' Willingness-To-Pay towards Eco-Friendly Farming Technologies: Case of Adoption of Parachute Technology

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The controversial issue of an excessive usage of chemical fertilizers in paddy farming led scientists to investigate on and invent environmentally-friendly production technologies (EFTs) such as 'Parachute Technology' that enhances the efficiency of fertilizer uptake. What factors trigger farmers to adopt EFTs in the field, and more importantly, the "role of economics" in adoption of such technologies is, however, not yet fully disclosed. This study, in particular, explores the outcome of an economic analysis carried out to determine the Willingness-To-Pay (WTP) of farmers, as potential end-users, for Parachute Technology. Data were collected by way of face-to-face interviews supported by a structured- questionnaire from a set of farmers (n=120) registered with a multi-stage multi-criteria project on production and promotion of EFTs in Kurunegala and Anuradhapura districts. Choice experiment method was employed to elicit their Marginal WTP for individual attributes. The estimates from Conditional Logit model revealed that certain attributes, including 'low environmental damage' (i.e. the highest value of Rs. 7,872), 'requirement of training' (Rs. 5,183), 'integration ability with other EFTs at the beginning' (Rs. 4,099) and 'low fertilizer wastage' (Rs. 2,488) possess a significant relationship with farmer's WTP. These imply that the farmers, in general, exhibits positive attitudes and willing to pay relatively high prices for eco-friendly attributes associated with EFTs like Parachute Technology, but needs to expose them to a facilitative process along with financial packages to offset short-term benefits of chemical fertilizer use.

Keywords: Choice experiment, Eco-Friendly technologies, Marginal willingness-to-pay, Parachute technology

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Remittances, Expenditure Pattern & Gender: Evidence from Urban Sector of Sri Lanka

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Migrants' remittances take an important position in Sri Lankan economy while it significantly affects people's livelihood, social processes, and economic development in individual household. However, none of research has carried out to reveal expenditure pattern especially within the households in urban sector of Sri Lanka. Therefore, this study examines migrant remittances on expenditure pattern of households in urban sector of Sri Lanka. Household Income and Expenditure Survey (HIES) conducted by Department of census and statistics in Sri Lanka 2009/2010 period was used as the secondary data in this study. Urban Sector migrant data set comprises 893 households. Fractional logit models were used within the Engle's curve framework to investigate how the gender of the household head and remittances effect expenditure pattern. Results reveal that, within male-headed household, internal remittances spend more on food while allocate least expenditure on other ad hoc purchases such as transport and entertainment expenditures while international remittances spend more on health while spend less on education. Further, results suggest that within female-headed household, internal remittances spend more on housing expenditure while spend less on education. On the other, female-headed household spends international remittances more on housing expenditure while spend less share in education expenditure. Finally, the study concludes that head of the household play a significant role in the remittance's allocation on food, housing, health & other expenditure.

Keywords: Expenditure pattern, Fractional logit model, Remittances, Urban sector

Analyzing the Promotion of Local Healthy Fast Food through *Hela Bojun* Project

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The fast food industry in Sri Lanka has been expanding rapidly since it is convenient for busy life style and reduces the effort of preparing meals. Although fast food is very popular among community, people are aware of adverse impacts of fast food consumption such as overweight, obesity and non-communicable diseases. Having understood the changing lives styles, eating trends and associated problems the Department of Agriculture launched the "*Hela Bojun*" project. The main purpose of the *Hela Bojun* project is to promote local healthy fast food with a high nutritional values. In this context, this research was designed to examine the factors that affect on the consumption of local healthy fast foods through *Hela Bojun* outlets. The specific objective of the research was to study how value negotiation of product and overall satisfaction relate to the marketing mix elements influence customers to select *Hela Bojun* outlets. To accomplish the objectives, a semi-structured questionnaire was prepared and direct interviews were conducted with 150 customers who visited five selected *Hela Bojun* outlets. For data analysis, Chi-square test of independence was applied. The results revealed that occupation, supervision of the Department of Agriculture, peer influence and purchasing local healthy fast food for special occasions were significantly associated with frequency of visiting *Hela Bojun* fast food outlets. Furthermore, the multiple linear regression analysis revealed that the age, number of family members, distance to *Hela Bojun* outlet and value negotiation have a significant relationship with the frequency of visiting *Hela Bojun* fast food outlets. Moreover, it was revealed that the value negotiation influences significantly and positively on the selection decision of *Hela Bojun* outlets.

Keywords: Consumption of local healthy fast foods, *Hela Bojun* outlets, Value negotiation

Analysis of Present Status and Production Forecasting of Potato Farming in Sri Lanka

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Potato is one of the most important cash crops in the upcountry Sri Lanka where majority of farmers depend on it as their main livelihood. Despite its importance to the economy, Sri Lanka mainly depends on the importation of potato from low cost producing countries which is a huge burden to the government. Under this background, this study aims to analyze the present scenario of the potato industry in Sri Lanka with a view to forecast the potato production of future. The Box Jekins Autoregressive Integrated Moving Average (ARIMA) time series model has been employed for forecasting the potato production and production data obtained from Department of Census and Statistics for the period of 1997-2017 were used. The descriptive analysis shows that self-sufficiency ratio in potato has not improved over the past few decades and there is a 5.28% import dependency. Moreover, potato importation bill has increased over the years from 1.30 billion LKR in 1997 to 5.44 billion LKR in 2017. In the meantime, 6.78% increase in cost of production over the last two decades has been resulted in farmers reluctant to continue potato farming as their livelihood. Among the inputs, seed cost contributed to the highest share of the total cost of production. In spite of that profitability of the potato farming has been increased by 7.81% (Department of Agriculture) over the years. The study also revealed that the best models are ARIMA (0, 0, 1) and ARIMA (2, 0, 0) for future forecasting. Therefore, this forecast would be useful for the policy makers to foresee the future requirement and the government to take measures to enhance the production capacity to cut the burden on country's food import bill.

Keywords: ARIMA, Potato, Production, Time series model

Organic Fertilizer Producers in Sri Lanka: An Assessment of Constraints along the Value Chain

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Annually Sri Lankan government spends nearly US$ 12,000 for the importation of inorganic fertilizer which is the highest expenditure among the intermediate goods import to the country. The frequent and continuous application of inorganic fertilizers into agricultural fields and its impact on human health and the environment are also rising concerns. In light of these, all stakeholders in the agriculture sector are, strongly encouraged to move from an inorganic to "organic fertilizer". This study examines the constraints faced by producers who were practitioners along the value chain of solid organic fertilizer in Sri Lanka. The potential constraints were identified through review of literature and were further verified by means of a series of focus group discussions with academics, government officers and producers involved in organic agriculture. A structured questionnaire was developed embedding the constraints into a set of statements (n=25). A field survey was carried out to explore the perceptions of organic fertilizer producers (n=65) who have been engaging in "organic farming practices" through 04 registered organic groups in the Kandy and Kurunegala districts. The producers were asked to indicate their views on each statement on a 10-point likert-scale ranging from "strongly disagree" (1) to "strongly agree" (10) [with "neither disagree nor agree" in the middle (5)]. The Exploratory Factor Analysis techniques were employed to analyze data, and the mean score of each statement. The outcome of statistical analysis sorted the 25 constraints stated into 7 key constructs, namely: 'Production' (P 1-6); 'Institutional' (I 1-5); 'Market' (M 1-3); 'Financial' (F 1-3); 'Human resources' (H 1-3); 'Public & health' (PH 1-3), and Regulatory (R 1-2). The greatest constraints faced by producers include: "Time taken to certify (3.7) and produce (2.5)", "Government support" (2.2), "Availability of certification bodies (2.1)". The outcome of analysis, suggests that the creation of an incentive-based regulatory framework supported by institutions to work on a fast-track certification is of paramount importance for organic fertilizer producers to retain in the value chain by disregarding the "conceivable benefits" of use of inorganic fertilizer.

Keywords: Constraints, Organic fertilizer, Producer perceptions

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Factors Affecting Tourists' Willingness Towards Agro-Tourism

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Agro-tourism is an emerging and very prospective sub-sector of tourism which is still the infant stage in Sri Lanka. Agro-tourism is an important alternative source of income for rural dwellers including small-scale farmers in many countries of the developing world. There should be basic facilities to start and operate an agro tourism destination and hence, it has an ability to generate benefits for the owner and the surrounding community. To develop the agro tourism sector of the country, it is important to carry out research studies to generate a comprehensive understanding. The objectives of this study are to find consumer willingness towards Agro tourism in Sri Lanka and to identify potential agro tourists, identify their attitudes and preferences. To accomplish the objectives of the study, a semi- structured questionnaire was prepared and direct interviews were conducted with both local and foreign tourists who visited tourism destinations in Ella, Sigiriya and Anuradhapura. In the survey, 100 local tourists and 150 foreign tourists were selected using convenient sampling method. Chi-squared analysis was used to find the factors that affect the willingness of tourists on agro-tourism. While 19 factors were analyzed by chi-squared test, results showed that 13 factors influenced on the willingness of foreign tourists on agro-tourism. Furthermore, only occupation, education, tourists' expectation, days which are preferred to stay in a farm and facilities significantly affect the willingness of local tourists on agro-tourism.

Keywords: Agro-tourism, tourists' willingness, tourists' attitudes

Development of Creamed Coconut Sauce (*Cocos nucifera*)

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Coconut kernel is a rich source of carbohydrate, protein, lipid, dietary fibre, minerals and it imparts numerous health benefits. The present study was conducted to develop a creamed coconut based sauce. Seven sauce samples were prepared using different proportions of creamed coconut and chili powder in weight basis as the main ingredients (50:50, 60:40, 70:30, 80:20, 85:15, 90:10, 95:05). Other ingredients used were sugar, xanthan gum, cinnamon powder, water, salt, vinegar, pepper powder, onion and garlic. Based on the standard pH (4.9-6.2) and Brix value (higher than 22%) stipulated by the SLSI for coconut cream based products, samples containing creamed coconut and chili powder in proportions of 85:15, 90:10 and 95:05 were selected for sensory evaluation. These samples were evaluated for appearance, texture, taste, odor and overall acceptability by 30 untrained panelists. Sensory data were analyzed by Friedman non-parametric test ($p<0.05$). Brix and pH values of the selected sample were measured and its proximate composition was analyzed using standard AOAC procedures. Its rancidity was measured as peroxide value over a period of 48 days. The sample containing 90% creamed coconut and 10% chili powder and received the highest overall acceptability. Therefore, it was selected as the best product. Brix and pH values of the selected sample were 35.7±0.1 and 4.93 ±0.01 respectively and its carbohydrate, protein, sugar, total fat and moisture contents (percent by mass) were 20.8 ±0.1, 5.0 ±0.2, 9.7 ±0.15, 34.9 ±0.3, and 26.29 ±0.02 respectively. Further it contained 417.3 kcal/100 g of energy. Peroxide value of the selected sample after 48 days remained low (14.8 meq $Kg^{-1)}$ indicating its storage stability. Shelf stable coconut cream based sauce with high consume acceptance can be prepared by using 90% of coconut cream and 10% of chili powder as the main ingredients.

Keywords: Chili powder, Creamed coconut, Sauce

Factors Affecting the Buying Intention of Ceylon Organic Tea by Foreign Consumers

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Changing food consumption patterns of consumers seem to be one of the big threats for living a healthy life. The conventional agriculture which uses chemicals and fertilizers ruin the environment and human being's lifestyle. Therefore, the organic agriculture started booming up in many countries by taking the advantage of capturing the health-conscious consumer markets in providing organic foods for their daily intake. Being an attractive world tourist destination while knowing the best quality tea producer, Sri Lanka attempted to expand its markets since 1983. But the organic tea consumption of the local people in Sri Lanka become lesser than the organic tea consumption of the tourists' who visit Sri Lanka annually. Therefore, this research focuses to identify the factors affecting the buying intention of Ceylon organic tea by foreign consumers. The first part of questionnaire covers customers' demographic information and the second focuses on consumer knowledge, health consciousness, environmental concern, product attributes, perceived price, trust and perceived quality. Questionnaire survey was conducted and the data were collected from 100 respondents in two selected destinations of foreign tourists (Colombo and Ella area). The results obtained were analyzed using descriptive statistics and multiple linear regression model. The findings of this study were identified the buying intention of foreign consumers in Sri Lanka towards Ceylon organic tea. It would assist practitioners, researchers and marketers to understand which factors are important to apply for their future research or business strategies.

Keywords: Buying intention, Ceylon organic tea, Multiple linear regression

Economics of Selected Domestic Food Crops: A Case Study in Badulla District, 2000-2017

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Agriculture is the principal form of livelihood for substantial fraction (57.3%) of population in Badulla District (Department of Agriculture, Sri Lanka). In spite of high incidence of poverty in Badulla district, climatic conditions are favorable for cultivating of domestic food crops such as potato, tomato, pole bean, maize and capsicum which are the most leading food crops in the area. Therefore, this study aims at comparing the profitability of leading food crops in the Badulla district and to analyse the resource use efficiency of these crops for the period of 2000-2017. The Cobb- Douglas production function was applied for each crop separately to compare the resource use efficiency. The study results show that 70% of the variance in the dependent variable can be predicted from the independent variables used in the models. Among the inputs, agro chemicals, hired labor and machinery indicate negative relationship with the gross income for these selected crops. The summation of output elasticities are greater than one (1) in pole bean (*Maha* season 1.3524 and *Yala* season 1.1295) which means its production function has increasing returns to scale. This implies that increasing expenditure on resources for pole bean cultivation can help farmers to obtain higher income than their expectation. Furthermore, capsicum and tomato in *Maha* season also have increasing returns to scale. In addition, potato, maize and tomato in *Yala* season indicate decreasing returns to scale implying inability to obtain the benefits from returns to scale. Moreover, profitability analysis shows that, pole bean in *Yala* season and tomato in *Maha* season has the highest increment in the profitability compared with other domestic food crops in Badulla district. Therefore, the study suggests diverting resources from less profitable crops to high profitable crops in order to enhance the resource use efficiency and to improve the living conditions of the farmers in the area.

Keywords: Badulla district, Domestic food crops, Input use efficiency, Returns to scale

Exporters' Willingness to Adopt Tea Hub Concept in Sri Lanka

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As one of the leading tea growing and exporting countries, Sri Lanka needs to adopt new strategic decisions to strengthen the sector along with the competitive global tea market. As a consequence, the concept of tea hub has been introduced by the industry experts and some parties as a strategy, in which liberalization of tea imports for blending, value addition and re-exports could be steered. Nevertheless, this concept of tea hub has been a controversial topic in the industry with the argument on to make the whole country as a tea hub or establishment of a tea hub in a separate free zone within the country. The exporters are the major proponent of this tea hub concept as well as major party whom to be privileged from it. With this background, the study has focused on the factors affecting on exporters' willingness to adopt tea hub concept in Sri Lanka and identify the most preferred hub model among exporters. The primary data were collected using a structured questionnaire from 41 tea exporting firms in Sri Lanka. The eight factors were used to measure exporters' willingness on tea hub concept. The current status of importation of tea, bulk tea export volume and satisfaction on tariffs and non-tariffs affected on exporters' willingness to adopt tea hub concept. According to the results of Probit regression, the current status of importation of tea was significant at 5% significance level and, bulk tea export volume and satisfaction on tariffs & non-tariffs were significant at the 10% significance level. The current status of importation of tea has a positive relationship with the exporters' willingness to adopt tea hub concept, while the bulk tea export volume and satisfaction on tariffs & non-tariffs were negatively affecting on exporters' willingness to adopt tea hub concept by exporters. This study concluded that the majority of the exporters (66%) are willing to adopt tea hub concept and prefer to have an exclusive free zone (55%) as a tea hub in Sri Lanka.

Keywords: Liberalization, Multi-origin tea, Tea exporter, Tea hub, Tea imports,

Evaluation of Tea Center Concept: A Study of Customer Satisfaction with Special Reference to Hayley's Plantation Sector

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Tea Center concept is emerging in Sri Lankan tea industry as an innovative business model to attract new set of customers. However, in today's competitive market attract new customers and retain them mainly depend on customer satisfaction. Therefore, this study examines what factors contributing to high level of customer satisfaction towards Tea centers while identify potential strategies to enhance customer satisfaction. Simple random sampling technique was used to select 300 respondents from Tea Centers of Hayley's plantation sector and pre-tested, self-administrated structured questionnaire was used to collect data. Ordered logit regression analysis, Chi-square test and multiple response analysis were performed to obtain results. The results revealed that product quality, service quality and price fairness significantly affect to the customer satisfaction. Most influential reasons to attracted customers for tea centers are; to have best quality tea & to buy made tea product, higher potential to buy organic tea. Further, results revealed that most of the respondents are preferred to participate recreational activities, factory tour and tea tasting sessions. Marketers in tea centers can be used above identified potential strategies to capture the market while enhance the satisfaction of customers.

Keywords: Customer satisfaction, Price fairness, Product quality, Service quality, Tea center concept

Skilled Based Migration from Sri Lanka -A Descriptive Analysis

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Skilled based migration has gained importance in recent years reflecting the impact of globalization, revival of growth within the economy and rapid growth in information and communication technology. By now, migration of skilled workers from developing countries has become a persistent trend. In Sri Lankan context, the most pressing issue is the mismatch of number of workers demanded by the foreign countries and supplied from Sri Lanka according to the level of skill. For this research, secondary data were obtained from SLBFE (Sri Lanka Bureau of Foreign Employment) annual reports for 12 countries over the period of 2009-2017.The results indicate that, total migrant flow has increased considerably after 2012 with the highest flow recorded in 2014. However, after the year 2014, a gradual of total migrant flow is observed. Moreover, in every year the number of male migrants is higher than that of female. Qatar has become the most preferred destination for skilled migrants and the highest number of migrants were from skill-level category throughout all the years. Population, unemployment rate, dependency ratio of destination and distance between destination and Sri Lanka were found to be moderately negatively correlated with the migrant flow whereas GDP growth of destination was moderately positively correlated with the migration flow. The findings of this research suggest that Sri Lankan migrants more concern about the conditions of the destination country rather than the conditions of the origin country.

Keywords: Descriptive analysis, Skill-based Migration, Sri Lanka

Entrepreneurship & Organizational Development

- Change Management or Organizational Development
- Human Resource Management
- Innovation and Entrepreneurship
- Law, Ethics and Social Responsibility
- Organizational Behaviour
- Strategy and Global Trends

Impact of Effective Succession Planning Practices on Employee's Retention (With Special Reference to Private Business Organizations in Sri Lanka)

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In recent times, business organizations have recognized effective succession planning concept as one of the key aspects of managing employee's retention. Although, as a result of employee's unawareness most of the organizations do not intend to implement succession practices. This research explores the impact of effective succession planning practices on employee's retention with special reference to private business organizations in Sri Lanka. The researcher conducted a field survey and collected data across 100 middle-level managers in top ten private organizations according to the LMD report 2017. A standard questionnaire was used as a data collecting technique and convenience sampling method was used to select the sample. The data were analyzed by using descriptive statistics, correlation, simple regression, and multiple regression analysis with the support of SPSS 21version. The results show that employees almost agree with the existing effective succession planning practices used in each particular organization. Performance Goal Orientation was strong positively correlating with effective succession planning practices and employees retention. Research proved that there is a positive impact from effective succession planning practices to the employee's retention. Management Involvement and Diversity Management are the highest and lowest contributory dimensions on employee retention respectively. Results revealed that performance goal orientation Moderator does not stronger the relationship among effective succession planning practices and employee retention. Effective succession planning practices mostly affect for the employee retention and research suggested managers to select the most appropriate succession practices in business context. The results provide various implications for filling the knowledge and empirical gap within the research context. Finally, it will also contribute to the top level managers and as well as future researchers in the same research area.

Keywords: Employees retention, Effective succession planning practices, Performance goal orientation

Exploring Employees' Work Life Conflict in Sri Lankan Software Development Firms

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In the era of technology, information technology plays a crucial role and the growing demand for the industry has resulted the software development sector to be highly aggressive and competitive. Consequently, the employees working in software development firms experience blurred boundaries between work and personal life as the industry consists of high work pressure, tight deadlines, long and irregular working hours making it challenging for its employees achieve a successful work life balance. Moreover, past literature indicates that the employees of software development sector to be highly affected by work life conflict. A cross-sectional study was conducted with the research objective of investigating the presence of work life conflict among employees in Sri Lankan software development firms and the key sources causing work life conflict. The research follows a mixed approach and the quantitative data has been collected through a questionnaire survey from 370 employees whereas 14 in-depth interviews were conducted as qualitative data, in order to gain more insight into the issue of work life conflict among the employees. The research findings indicated that the employees may be demonstrating signs of work life conflict, high perceived work overload, low organizational commitment, work burnout, personal burnout, low job engagement and poor health. The number of actual working hours was revealed to be significantly higher than the standard working hours. As a solution, it is recommended to monitor the number of working hours of employees and examine the reasons behind long working hours in the industry. Furthermore, implementing work life balance programmes to address the issue of work life conflict will benefit both the employers and employees in Sri Lankan software development firms.

Keywords: Work life conflict, Work life balance, Sri Lankan software development firms, Sri Lankan IT industry

Denim Reconstruction Method as a Sustainable Approach for the Fashion Industry in Sri Lanka

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The research seeks the possibilities and extend the limitations of fashion reconstruction method through the denim material for the Sri Lankan fashion industry. It has become one of the most polluting industries in the world. With this perspective reconstruction, 3R concept and sustainability have become the contemporary global trends in the fashion industry. Fashion was rapidly grasped by the local individuals rather than accepting the sustainability concept, caused by the lack of designer intervention and a proper platform. Therefore, the research was focused on introducing sustainability to the local fashion industry through reconstruction method. Hence, the research was limited to the denim material due to its comparatively high durability, stability, comfortability and re-usability. The main objectives of this research were to make a designer platform for Sri Lankan sustainable fashion industry, deliver fashionable solution for the clothing wastage and bringing them back to life, awareness building, contribute to the sustainability and breaking the local fashion barriers. The research was basically experiment and practice led one. Secondary data was gathered about global reconstructed fashion history and trends, denim material and arise of the DIY (Do It Yourself) crafts (related to garment reconstruction) by pursuing the literature. The grounded design theories: *"Wabi Sabi"* concept (theory of imperfection), Design elements and principle were applied for the final executions. As to the outcome of the research, three different construction techniques were identified as layering, mismatching and mixed placing. The silhouettes were derived as one of a kind and spontaneous end results as followed the above techniques.

Keywords: Sustainable fashion, Fashion reconstruction, 3R concept, Fast fashion

An Assessment of the Struggle on Improving Global Competitiveness of Japan: Focus on the Recent Policies and Practices of Global Human Resource Development

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The struggle of Japan for improving the global competition has started recently by focusing on the human resource development aspect. Data was collected from the Ministry of Education and academic journals. Pros and cons of recent policies and practices have been analyzed to see how the situation can be improved. Japan is known as a country for quality products and advanced technology. While there are many examples for original ideas and technology emerged in Japan, production bases are not confined to Japan. In fact, to cope with extensive global competitiveness with other countries, many Japanese companies were forced to locate their production activities to bases outside Japan. However, although heavy investments were made by the Japanese companies abroad, possibility to contribute overseas operations by the Japanese employees had remained a question unanswered. Nevertheless, Japan started to realize the weaknesses of conventional human resource development practices in order to cope with the rapidly expanding globalization trend of the country. It is common for the young human resources also to use the trend of globalization for expanding their activities beyond the national boundaries, such as by seeking jobs or study opportunities abroad. However, it was the opposite for Japan during the recent past. For example, while students in the countries such as India and China show a rapid increase (increased to 265% & 398% respectively) for higher studies in other countries, Japanese students show a decreasing trend (decreased to 72%) over the 2002-11 period. It was argued that the lack of interest on foreign studies by the Japanese students would negatively impact on the job placement in other countries. The government realized that this situation would hamper the effort for improving the global competitiveness and therefore initiated several new projects. It is now the time to assess how such policies and practices have impacted on improving global competitiveness.

Keywords: Global competitiveness, Foreign investment by Japanese companies, Global human resource development, English education

Impact of Subjective and Objective Job Monotony on Psychological Distress (With Special Reference to Apparel Sector Blue-Collar Women Workers)

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Job monotony is a flagrant issue and psychological distress is an ardent issue in present organizational context, especially for blue collar workers in labor oriented organizations. Apparel industry is one of the sectors, significantly contributes economic growth in Sri Lanka by involving in employment creation and foreign exchange generation. Job monotony and psychological distress are two emerging problems in the apparel industry. However, limited researches have been conducted on job monotony and psychological distress by combining dimensions of both subjective and objective job monotony. Therefore, this study is conducted in order to identify the relationship and impact of subjective and objective job monotony on psychological distress of women blue-collar workers in apparel industry. Researcher has considered above aspects and model was developed by combining dimensions of job monotony with psychological distress. Data were collected across six major high performing apparel companies in Katunayake KPZ, based on capability report and used convenient sampling technique. Data analysis was performed using Descriptive Statistics, Pearson Correlation Analysis, Simple Regression Analysis and Multiple Regression Analysis. Results of the analysis indicated that, subjective and objective job monotony significantly and positively affects to psychological distress and high contribution was observed from objective monotony. Outcomes of this study provided implications on enhancing available literature, to understand the existing level of job monotony to policy makers and to managers and thus help them to alter or enhance the policies. This study also suggests some further research areas for future research.

Keywords: Export processing zone, Job monotony, Objective monotony, Psychological distress, Subjective monotony.

Impact of HRM Practices on Organizational Performance of Selected Private Hospitals in Andhra Pradesh, India

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Health care is now an upcoming field in most cities in India. Managing human resources especially hospitals are major challenges at present scenario. Human resource management practices are essential for retaining effective professionals in hospitals. The performance of any organization is based on only through the performance of the employees. The purpose of this paper is to examine the relationship between the HRM practices and organizational performance. Most HRM practices adopted by hospitals are having recruitment and selection, training and development, performance appraisal, team work, salaries and wages, compensation and rewards. The components of organizational performance are motivation, leadership team, work environment and values, capabilities and co-ordination and control. For this study, researcher used convenience sampling technique to collect data. Hence, 200 questionnaires were distributed and received 142 from Ramesh hospitals in India. The processes include staffing and recruitment, under which it was observed that the hospital management verifies the existence of staffing patterns for the hospital organizational structure and the levels of each post are clearly indicated and displayed in each department. Employees with skills to lead transformation face greater demand**.** Organizations incorporate higher increases in compensation for health system focusing on transformation. Annual incentive programs are placing increased emphasis on value-based measures. As the conclusion, good HRM practices implementation in hospitals makes the physicians, nurses, and paramedical staff to bring better results in respective of organization and employee hidden skills. Hospitals maintain their workforce by providing better reward system that will motivate them to better work performance. Hospitals need to focus on the best HRM practices in order to achieve their goals and objectives and also to survive in the competitive environment.

*Keywords***:** HRM practices, Organizational performance, Effective professionals, Performance, Transformation

Knowledge Management Enabler Factors and their influence on Organizational Performance (With Special Reference to the Companies Registered under Colombo Stock Exchange)

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As the pace of global competition quickness, executives have realized that their edge lies in more efficiently transferring knowledge across their organizations. However, only few organizations have understood the importance and benefits of knowledge management (KM) practices. The objectives of this study is to identify the existing KM enabling factors and explore the effect of KM enabler factors on organizational performance where very little research has been conducted up to date. A quantitative method was used and data were collected through both primary and secondary sources to measure KM enabling factors and performance respectively. The questionnaires were distributed to all listed 298 companies through online survey and personnel contacts in order to measure KM enabling factors and 90 responses were received. Hence, average profit was obtained from CSE statistics to measure the organizational performance. Data were analysed using Factor Analysis, Descriptive Analysis, Correlation Analysis and Multiple Regression Analysis. The findings shown eight major KM enabling factors based on the factor analysis and out of them three factors namely leadership, culture and technology & measurement have positive influence on organizational performance. Therefore, it is necessary for management to pay more attention on above factors while implementing KM strategies in an organization. This study contributes to bridge the existing literature gap to a certain extent. Future research on new elements that would influence on implementation of knowledge management is proposed.

Keywords: Knowledge management, Knowledge management Enabler factors, Intellectual capital, Global competition.

Impact of Organizational Learning Climate on Innovative Work Behavior (With Special reference to the Middle Level Employees in Apparel Industry Sri Lanka)

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In recent times, innovative work behavior is the most important component in achieving competitive advantage. According to scholars, innovative work behavior is an essential part of the organization to sustain within the complex environment. However, limited research attention has been given in identifying the impact of organizational learning climate on innovative work behavior. Therefore, this research is conducted in order to identify the relationship and impact of organizational learning climate on innovative work behavior. By considering the above objectives, a model was constructed to identify the existing level, relationship and the impact between organizational learning climate and innovative work behavior and relative contributing factor of organizational learning climate dimensions on innovative work behavior. Data were collected across 3 major apparel leading manufacturers within Sri Lanka based on LMD ranking 2017 using convenient sampling technique. The Sample consisted of 120 middle level employees from 3 major apparel leading manufacturers. Data were analyzed by using Descriptive Statistics, Pearson Correlation analysis, and Simple and Multiple Regression analysis. Results concluded that impact of organizational learning climate significantly and positively impacts on innovative work behavior. The results of the study will be useful for practitioners and managers as this will drive them to alter or enhance the policies. This study also suggests some future research areas for further studies.

Keywords: Organizational learning climate, Innovative work behaviour, Apparel industry, LMD ranking, Middle level employees

Investigating the Influence of E-HRM Practices on Organizational Performance: The Mediating Role of Organizational Agility (With Special Reference to Financial Institutions in Sri Lanka)

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Electronic Human Resource Management (E-HRM) came into existence as a result of the evolution of new technology and it leads to eliminating the administrative burden on HR professional. Financial institutions are the heart of financial stability of the economy. Nowadays, most of the financial institutions are widely adopting the E-HRM practices in order to achieve a sustainable competitive advantage. However, it has been observed that there is a lack of empirical studies regarding this phenomenon in Sri Lankan context. The main contribution of this study is to enrich the knowledge and investigate the impact of E-HRM practices on organizational performance under the mediation role of organizational agility. Thus, the study was based on four objectives. First, to identify the existing level of E-HRM practices in financial institutions, second, to explore the relationship between E-HRM and organizational performance, third, to examine how E-HRM impact on organizational performance and finally, to determine the mediating role of organizational agility between E-HRM and OP. Questionnaires were distributed by using convenience sampling method to collect primary data from 40 financial institutions in Sri Lanka. Data analysis was performed using Pearson Correlation analysis, Regression analysis, Descriptive statistics, Baron and Kenny Mediator analysis method and Sobel test. Results of the analysis indicated that E-HRM practices significantly and positively impact on organizational performance while organizational agility mediate the relationship between E-HRM practices and OP. Outcomes of this study provided implications like enhancing available literature, to understand the real impact of E-HRM on organizational performance to HR managers. This study also suggests some further research areas for future research.

Keywords: Electronic human resource management, Organizational performance, Organizational agility

Entrepreneurial Intention of Prisoners in Sri Lanka

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Development of entrepreneurship concept is directly involved with entrepreneurial behavior and thus it has become an important topic to study. Prisoners are a kind of inactive and untouched category in the society that could be used to contribute the development any country. Prisoner's unemployment is one of the major factors that caused a higher rate of recidivism. Given the lack of empirical and the divergent finding of intention of entrepreneurship, this study investigated the nature of entrepreneurial intention of prisoners in Sri Lanka. Convenience sampling method and stratified sampling method were employed to select 150 prisoners from the prison institution of Sri Lanka. Data were gathered by using self-administered questionnaires and interviews. Hence, Correlation, Multiple Regression, and Thematic Analysis were used to analyze data. The results revealed that the existing level of attitudes towards the behavior and entrepreneurial intention were almost agreed by the prisoners while they moderately agreed with the existing level of subjective norms and perceived behavioral control. Alongside, it was found that attitudes towards the behavior and perceived behavioral control strong positively influence the entrepreneurial intention while subjective norms weak positively influence the entrepreneurial intention. The study contributes to the existing knowledge and suggests that the government should pay more attention to enhance the entrepreneurial intention among the prisoners. Further, study also provided areas for future researches.

Keywords: Attitudes towards the behavior, Entrepreneurial intention, Perceived behavioral control, Subjective norms

Knowledge Management through E-HRM: A Review

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The organizations in the 21st century is facilitated with effective achievement of organizational objectives with the technology in smoothing the Human Resource Management (HRM) function in the form of introduction of electronic Human Resource Management (e-HRM) to the management sphere. Thus, this review aimed at to articulate and synthesis the theoretical knowledge related to electronic human resource management (e-HRM) by devoting content to specific areas as explanations of e-HRM as a concept, the theoretic groundwork e-HRM, the role of e-HRM, the various categories of e-HRM, factors affecting to e HRM and necessary conditions for an effective e-HRM implementation along with a strong empirical justification of e-HRM on knowledge management by using the qualitative content analysis as the methodological basement. In achieving this purpose, about fifty sources of literature were investigated including books, both published and unpublished journal articles, conference papers and posters. The findings reveals that there is a positive relationship between Knowledge Management and e – HRM that will lead to strengthen the organizational innovations through knowledge sharing, retention and accessing the organizational knowledge by achieving organizational objectives effectively. Nevertheless, there is a deficiency in the researches which is directed towards this area and need more focus on identifying the influence of e-HRM on knowledge management to a deeper extent.

Keywords: Information technology, e-HRM, Knowledge management, Human resource

The Impact of Enterprise Resource Planning (ERP) System on Operational Performance of Listed Companies in Sri Lanka: Special Reference to Manufacturing and Beverage, Food & Tobacco Sectors

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Today, the business world is more dynamic and organizations find difficulties to survive with manual work. Stand-alone, isolated systems do not facilitate operations throughout the organization. Therefore, many organizations have been welcoming the IT solutions such as ERP system to gain competitive advantages and be successful. This research investigates the impact of ERP system on operational performance in listed companies in Manufacturing and Beverage, Food & Tobacco sectors. To attain the objectives, quantitative method was used and data were collected through self-administered questionnaires. A total of 50 questionnaires were distributed among the companies those were selected from 298 of the population by using stratified sampling technique. Hence, Correlation Analysis was used to analyze the relationship between ERP system and operational performance while Regression Analysis was utilized to determine the influence of most significant factor of the ERP system on operational performance and descriptive statistics was also used to identify the level of existing ERP system practices in selected companies. The result of this study demonstrated that there is a strong positive relationship between ERP system and operational performance. Further, training on IT and process and user satisfaction are the key factors that influence mostly on operational performance. Hence, this study contributes to the existing literature and as the possible managerial implications, organizations need to offer more training on IT and process and vendor support. At the end of this paper, areas for future researches also provided.

Keywords: Enterprise Resource Planning (ERP) system, Training, IT process, User satisfaction, Operational performance

A Review of Literature on Venture Growth and Debacle: Elucidations of Factors Recounting to Small and Medium Scale Industry

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This review examined the literature in relation to the research topic; a review of literature on venture growth and debacle: elucidations of factors recounting to small and medium scale industry. The structure of the review is as follows. First, the concept of venture growth and organizational life has been examined briefly. Secondly, problems faced by small businesses and thirdly small business success and failure have been reviewed. Finally, the causes of small business success and failure have been examined. The literature review will be connected to the research issue at the end of this paper. The following general conclusions emerged from the literature on business failure. Growth of an organization does not occur at ones; it grows after passing through series of stages in its life cycle. It can be identified that there are internal and external problems in small businesses and if necessary steps have not been taken to overcome them by the business, those problems may ultimately end up with a failure of a business. There is no uniform definition for the success or failure of a small business and the failure rate of a certain industry depends upon the definition used to define failure. Small business Success and failure are two sides in the same coin. There is a similarity between causes of failure and causes of success. Factors, which affect the failure of business, affect the business adversely to the business where as factors which affect to the success of a business affect the business favorably to the organization. Most important factors, which affect the business failure or success, are micro level factors. Basically personal characteristics of the owner and managerial deficiencies are critical.

Keywords: Success, Failure, Small business, Life cycle

Impact of Employees' Protean Career Attitudes on Organizational Commitment (With Special Reference to Financial Sector in Kandy District)

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Over the last two decades in spite of multitude of models seeking to explain contemporary careers, protean career has become widely recognized concept with in the organizational literature. The concept of protean career has been tested as an employee commitment forms. Consequently, career literature is with contradictory arguments and little empirical evidences have been observed. This study attempts to investigate how protean career attitudes impact on organizational commitment. Mixed study method was used. Data were collected through self-administered questionnaires and semi structured interviews. Questionnaires were distributed to 100 employees and semi structured interviews were conducted among 20 employees by using convenient sampling technique. Data analysis was performed using Descriptive Statistics, Correlation Analysis, Simple Linear Regression Analysis, Multiple Regression Analysis and Thematic Analysis and finally Triangulation. The findings of the study revealed that protean career attitudes have significant positive relationship and impact on organizational commitment. Moreover, self-directed career management and value driven predispositions positively related to organizational commitment, while self-directed career management impacts more on organizational commitment than value driven predispositions. Findings of the study concluded that having a protean career attitude, individual does not automatically result in less organizational commitment. Study recommended that for organizations, it is important to provide development opportunities for their employees with better career management.

Keywords: Protean career attitudes, Organizational commitment, Contemporary career

Does Work Environment Matter for Employees' Productivity in the Public Sector in Sri Lanka?

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The human resource productivity has been identified as a significant national concern because of the inefficiently executed and loss-making state departments and enterprises in the current context of the public sector in Sri Lanka. Accordingly, this study is intended to investigate the impact of work environment on the productivity of Management Assistant employees of Divisional Secretariats by selecting the Anuradhapura District as the study setting. As a quantitative study complemented by explanatory research design the study collected data from 80 Management Assistant employees in Divisional Secretariat Offices in Anuradhapura district by using Stratified Sampling employing a self-completion questionnaire. The questionnaire consisted with two parts and first part was devoted to collect the demographic information of respondents while the second part was devoted to assess the work environment and the productivity of employees using five point Likert scale. The data analysis was performed by using Descriptive Statistics, ANOVA, Correlation and Regression Analysis by using SPSS 21.0 version. As per the findings all the predictors of the model (Physical Environment, Psychological Environment, and Social Environment) explained 20.7 % variation of employee productivity where psychological work environment and social work environment show significant impact on employees' productivity. Thus, it is recommended that employees' productivity can be increased by asserting high consideration on both psychological work environment variables as salary, health and safety, job security and social work environment as communication, performance feed- back, supervisory support, decision making, workplace culture and co-workers in the Divisional Secretariat Offices in Sri Lanka. The implications of the study is important to enhance the productivity of the human resource by placing more concern on both psychological and social work environment variables.

Keywords: Productivity, Physical work environment, Psychological work environment, Social work environment, Public sector employees

A Study of Factors Affecting the Effectiveness of Recruitment and Selection Process: A Case of a Reputed Banking Institute in Sri Lanka

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Research on recruitment and selection supports the notion that factors affecting the effectiveness of the process may be the predictors which lead to different positive organizational outcomes in contemporary organizations. Extant studies stress that many different factors affect the effectiveness of the recruitment process and selection process separately. However, relatively a few studies have tested factors affecting to the effectiveness of the recruitment and selection process of an organization in a qualitative nature. As a result, this study is especially focused on the qualitative aspects of factors affecting to the effectiveness of recruitment and selection process. Accordingly, the main aims of the present study are to examine the recruitment and selection process of the bank and identify key factors affecting towards the effectiveness of the process. To advance the understanding of these, narrative writing method and common theme analysis were used to identify the key factors of the process by conducting interviews with twenty key HR personnel in the case company. The study found that recruitment policy, political-social-legal considerations, cost of filling jobs, size of the firm, HR planning, company image, competitors and job analysis are factors affecting to the effectiveness of the recruitment process. Similarly, speed of decision making, organizational hierarchy, nature of the business, applicant pool and permanent address of the applicant are the factors affecting to the effectiveness of the selection process. Yet, the labour market conditions which are evident from the previous research; have not affected surprisingly on the process of the present study. Based on the results, this study contributes several theoretical and managerial implications such as hiring the most suitable candidate after a proper job analysis; at the appropriate time for the relevant position to make recruitment and selection process a success in banking institutes.

Keywords: Recruitment, Selection, Banking institutes

Quality of Visual Merchandising in Fashion Stores in the Batticaloa District

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Visual merchandising is a practice used in retailing to improve the desirability and differentiate the product, and to enhance the impulse buying behavior. Sri Lankan fashion retail sector have rapidly expanded, and the number of retailers have increased. However, the studies are limited to address the quality of visual merchandising. The aim of this study is to find out the level of quality of visual merchandising in fashion stores in the Batticaloa District. The visual merchandising was measured using the dimensions of window display, product display, mannequin display, store layout and fixtures, and promotional signage. Data were collected using simple random sampling techniques from 200 customers, representing three electoral zones in the District. The data was measured using Likert scale. Univariate and Descriptive statistical techniques were used for analyzing the data. Cronbach's Alpha value was used to test the internal consistency of the instruments, which shown a strong internal consistency. The overall quality of visual merchandising in fashion stores were in high level. The dimensions of window display, product display, mannequin display and store layout and fixtures were also recorded at high level by its quality. Whereas, quality of promotional signage shown moderate level. In addition, the sub dimensions of quality in store layout and fixtures, such as cleanliness and neatness of the store and store environment were also at the moderate level. Therefore, the retailers in fashion stores need to consider strategies for improving the quality in promotional signage, cleanliness and neatness of the store and store environment. Hence, application of more attractive visual merchandising practices leads to promote successful operation in retailing.

Keywords: Visual merchandising, Window display, Product display, Mannequin display, Promotional signage

Impact of Workplace Environment on Job Satisfaction: With Special References to University of Kelaniya

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A satisfied, happy and productive employee is the biggest asset of any organization. Earning such an employee is a challenge for contemporary organizations. As satisfied and motivated employees lead to the effectiveness and productivity of any organization, employers attempt to create a 'good workplace environment' to overcome afore mentioned challenge. A 'good workplace' indicates low levels of employee stress, employee appraisal systems and safe working environment. More scholarly work is required to examine if there is a relationship between a 'good workplace environment' and employee satisfaction. The objective of this study was to measure the impact of workplace environment on job satisfaction of the non-academic staff members of the University. This study was conducted in the University of Kelaniya and collected data through a close-ended questionnaire using random sampling technique from the non-academic staff members of the University (n = 210). The linear regression analysis to test the impact of workplace environment on job satisfaction suggested that R2 = .731 and adjusted R2 = .729 when the p value was .02. Hence, it can be concluded that there is an impact of workplace environment on job satisfaction. This study suggests that a conducive and properly designed user-friendly physical workplace environment is a necessity and the organizational success and significant effects of employee satisfaction are caused by a 'good working environment'.

Keywords: Workplace environment, Job satisfaction, Non - Academic staff, Employee efficiency, Working behaviors

Determinants of Revenue Collection of the Local Authorities in Trincomalee

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All Local Authorities (LA) have collected revenue to meet their budgetary obligations. However, the LA are unable to provide vital services to public as revenue collection is poor. Therefore, it is essential to identify determining factors of revenue collection in the LA. The objectives of the study were; to identify the effectiveness of computerized application in revenue collection of LA in Trincomalee, to identify the effectiveness of revenue monitoring and evaluation systems of LA in Trincomalee, to identify the effectiveness of revenue collection mechanism of LA in Trincomalee, to identify the level of complaint handling related to revenue collection of LA in Trincomalee and to examine the significant difference among the LA pertaining to revenue collection in Trincomalee. The target population of the study was employees of the LA in Trincomalee. Random sampling technique was applied to select respondents from the various departments of LA. Data were analyzed by Univariate Analysis and ANOVA using SPSS. The findings of the study revealed that Assessment Tax is the main sources of revenue. Further, study shown that computerized applications as well as revenue monitoring and evaluation systems in revenue collection of LA were low level whereas revenue collection mechanism and complaint handling were moderate level in the LA. Result of ANOVA indicated that there is no statistically significant difference pertaining to revenue collection in the LA. It was concluded that above factors are not accurately managed to collect revenue by all LA in Trincomalee. The study recommended that all revenue collection systems should be computerized and staff should be trained to properly collect the revenue of the LA.

Keywords: Local authority, Revenue collection, Computer application, Monitoring mechanism

The Study of Impact of Self- Motivation on Career Development of Female Nursing Staff (With Special Reference to Government Hospitals in Colombo District)

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Today's the health care industry has a higher demand on qualified medical professionals. There is least number of males joining within the nursing profession. But, combination of the tendency toward full time employment and higher career aspirations appear to be the reason that men are over represented in senior positions of nursing. The purpose of this research study was to identify the self- motivation on career development of female nursing staff of Sri Lankan Government Hospitals. The overall study has been structured based on the conceptual framework built up with reference to the four objectives, namely identify the level, relationship and impact of self-motivation on career development and moderator role of perceived organizational support (POS) on relationship of self-motivation and career development of female nursing staff. The quantitative research was conducted through stratified sampling technique by using self-administered questionnaire and 150 female nurses were employed as the respondents who are working at Colombo District Government Hospitals. Data analysis was performed using Descriptive Statistics, Pearson Correlation Analysis, and Regression Analysis through SPSS 21.0 Version. Results of the analysis indicated that, self-motivation significantly and positively affects career development but POS does not create any influence on this relationship. Finally, study suggests management of hospitals to provide good facilities in the physical working environment which will enhance their motivation to work while suggested to pay more attention on reducing nurses' work life imbalance by taking necessary steps and actions. Further, outcomes of this study provided implications for enhancing available literature. This study also suggests some further research areas for future research.

Keywords: Self-motivation, Career development, POS, Female nurses, Government hospitals

The Impact of Work-Life Balance on Job Performance of Administrative Officers of State Universities in Sri Lanka

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Healthy work-life balance is crucial in modern dynamic organizational setting to ensure productive work force. Previous studies have examined various factors influencing on work-life balance and its relationship with job performance on diverse occupations. However, findings of existing studies cannot be directly applied to the Sri Lankan context due to cultural and behavioral differences of people compared to Western countries. State university sector is now rapidly changing with several collaborations emerges with continuous establishment and growth of local and international private universities. Thus, the main aim of this study is to investigate the impact of work-life balance on job performance of administrative officers of state universities in Sri Lanka. The specific objectives of this study are to examine the relationship between work-life balance and job performance and to identify the significant family and work-related factors affecting job performance of administrative officers in state universities in Sri Lanka. The study considered 286 administrative officers representing all fifteen state universities in Sri Lanka and data was collected through self-administrated questionnaire. Based on the statistical results, hypothesis defined were tested to meet aforesaid objectives. It was found that, there is a positive relationship between work-life balance and job performance of administrative officers of State Universities in Sri Lanka. Further it was revealed that, relationship with partner/parents, colleague support, relationship with peers and flexible hours arrangement are significant factors which influence on job performance of administrative officers. The findings of this research study will be beneficial for senior management of state university system and policy makers for higher education sector to enhance work-life balance of administrative officers to have more productive and committed work force within state university system of Sri Lanka.

Keywords: Administrative officers, Job performance, State university system, Work-life balance

Emotional Intelligence and its Impact on Entrepreneurial Intention; the Role of Psychological Capital as a Mediator (With Special Reference to Entrepreneurial Undergraduates of Sri Lanka)

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Entrepreneurship plays an important role in economic prosperity and social stability of any country. Therefore, fostering entrepreneurship among students has become an important topic for universities, government agencies and research academicians in Sri Lanka. The dependent mentality of students is a huge hindrance for entrepreneurship within the country as it has been anchored in their minds from the initial stage. However, Universities have amended the curriculum and have taken measures to enhance an entrepreneurial culture within the country, but the outcomes seem to be very slow. Even though, studies revealed that a higher percentage of undergraduates are willing to be entrepreneurs, there is very low evidence that at least a majority of them have pursued their career as entrepreneurs after graduation. This study identifies the emotional intelligence and its impact on entrepreneurial intention while psychological capital as a mediator with special reference to entrepreneurial undergraduates of Sri Lanka. A sample of 160 undergraduates of the four main entrepreneurship degree offering universities were selected in terms of stratified sampling. Primary data were collected by using a structured questionnaire. In order to achieve the objectives researcher used Descriptive Analysis, Correlation, and Simple Regression Analysis while A.F. Hayes' Mediation Assessment Model and Process Model 04 also used to derive results. Findings revealed that there is a significant influence of emotional intelligence on entrepreneurial intention. Further, a significant positive influence of emotional intelligence on psychological capital and significant positive influence of psychological capital on entrepreneurial intention also observed. This shows that it is important for potential entrepreneurs to be equipped with psychological and emotional competencies to pursue an entrepreneurial career apart from the knowledge acquired. Therefore, entrepreneurial undergraduates should be given proper exposure to enhance their mental stability to cope with challenges.

Keywords: Emotional intelligence, Entrepreneurial intention, Psychological capital, Undergraduates

Challenging to Change: Skill Malleability and Job Search Behaviour

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Nowadays, organisations operate an aura of a dog-eat-dog environment characterised by unprecedented and unpredictable events mainly caused by technological advances and globalization. These circumstances are compelling the organisations to teach their employees time to time for acquiring all latest changes, nonetheless, employees' willingness, adaptability and readiness in response to such circumstances are open to question. Drawing on the resource-based view, the present study aims to investigate the relationship between skill malleability and job search behaviour. Anchored on robust ontological and epistemological assumptions, the study adopts a survey strategy with a deductive approach and cross-sectional time horizon. Data were garnered from 124 finance-sector employees with a self-reported questionnaire using a convenience sampling technique. As a caveat, common method variance has been examined for identifying potential bias of the non-probability sampling technique and single-source data collection. The study discloses a strong negative relationship between skill malleability and job search behaviour implying that employees who are lackadaisical in assimilating new skills and knowledge are thinking of leaving a job that incubates undesirable organisational outcomes. Importantly, organisational support moderated the relationship between skill malleability and job search behaviour such the negative relationship (at a high level of skill malleability) is stronger at a high level of organisational support, nonetheless, at a low level of skill malleability the negative relationship has been significantly reduced the strength of job search behaviour at a high level of organisational support. Needless to say, the study made a number of theoretical contributions to the frontiers of human resource management literature. The suggestions for future directions are also highlighted at the end of the paper.

Keywords: Skill malleability, Job search behaviour, Organisational support, Resource-based view

Conflict Handling through Grievance Handling: An Evidence from Apparel Industry in Sri Lanka

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This study is intended to identify the impact of grievance handling on conflict management in the apparel industry in Sri Lanka in order to address the question of "Does the grievance handling procedure impact on handling conflicts among employees in Apparel industry in Sri Lanka?" as one of the most significant innovations in industrial revolution. Accordingly, the study collected data from 120 employees in selected apparel companies in Kurunegala District by using stratified random sampling method. A structured questionnaire was used for the data collection where the first part of the questionnaire was devoted to collect the demographic information and the second part was dedicated to measure the dependent and independent variables using 5 points Likert-type scale. Descriptive Statistics, AVOVA, Correlation Analysis and Regression Analysis were used to analyze the data using SPSS 20.0 version. The Correlation Analysis between the dependent variable and independent variables were significant at 0.05 level of significance which indicate that the grievance handling procedure positively influences the conflict handling in the apparel context. According to the Multiple Regression analysis, the adjusted R square value was 0.404 where informal grievance capturing system and timeliness of the grievance handling were identified as significant at 0.05 level of significance. Based on the findings it can be concluded that an effective grievance handling procedure is essential for the apparel industry to address the conflict arise among the employees in order to maintain sound industrial relations. There, the organizations should pay a special attention to capture the grievances in informal ways and captured grievances should be addressed in timely manner. The findings of this research can be imply to the apparel industry to form effective grievance capturing and handling system policies and strategies to maintain the healthy atmosphere in the organizational context.

Keywords: Apparel industry, Grievance, Grievance handling, Conflicts, Conflict handling

Assessing Human Resource Related Risk Management Frameworks for Small-Scale Software Development Companies in Sri Lanka: A Systematic Review of Literature

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Risk factor is an unavoidable element that every industry domain is challenged with, including the software development industry. Dynamic changes followed by technological advancements transpiring in the industry has challenged the existence and evolution of software development oriented startups. As per the structured risk categorization defined in the literature, human resource related risk category is a significant category. The objective of this study is to propose a compatible Human Resource (HR) risk assessment model for small-scale software development companies. It is backed through critical evaluation of published and recognized models in different domains. Furthermore, expert opinions obtained via semi-structured interviews from the Sri Lankan software development industry justify the significant contribution of this study. The methodical review of literature is conducted underlying three main areas i.e. Risk assessment and ERM models, IT sector risks and Risk assessment, and Human resource-related risks and assessment. Since there is a wealth of literature from the study area, few risk assessment models were shortlisted after the process of initial screening for further evaluation considering the acceptability aspect of the research community. Thereby, globally accepted Ernst and Young Global HR risk assessment model was selected as the appropriate model to assess HR related risks that impacts small scaled software development companies and this study extends its capabilities via interpreting potential contingency plans to contribute those entities in the Sri Lankan context.

Keywords: Human resource related risks, Software development companies, Risk assessment frameworks

Physical and Mental Well-being and Job Satisfaction among Male Construction Workers in Selected Urban Construction Sites

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With the rapid expansion of construction industry in urbanizing areas of Sri Lanka, the health of the construction workers has become an aspect that is often neglected. The objective of this study was to assess the physical and mental wellbeing and job satisfaction among male construction workers in selected urban construction sites. A cross sectional descriptive study was carried out in a simple random sample of 120 male workers at three urban construction sites using an interviewer administered questionnaire. Socio-demographic factors, level of physical activity, nutrition and diet, alcohol and smoking, rest and sleep, energy and fatigue, pain and discomfort, level of mental wellbeing and level of job satisfaction of the workers were assessed. Data was analyzed using SPSS software (Version 24). A majority (73.3%) of the workers monthly earned more than thirty thousand rupees. A majority (42.5%) were engaged in vigorous physical activities. Most (56.7%) had normal BMI while only 20.8% were underweight, indicating a better level of nutrition when compared with the results from neighboring countries. Prevalence of alcohol use and smoking were 55.0% and 44.2% respectively, both significantly more prevalent than in the general population whereas 36.9% were consuming alcohol for more than 10 years and 9.4% were smoking more than 10 pack years. Majority (83.3%) were not fatigued and 66.6% had musculoskeletal pains, most commonly the back pain. Most had good mental wellbeing (99.2%) and good job satisfaction (94.8%). In conclusion the monthly income of majority of the workers was high and the overall nutrition was satisfactory whereas alcohol use and smoking were highly prevalent. Many suffered from musculoskeletal pains. Majority had good mental wellbeing and were satisfied about their job. Substance abuse and musculoskeletal pain were identified as the main issues and further studies of larger scale are recommended.

Keywords: Physical, Mental, Construction

Impact of Employee Recognition on Employee Involvement: The Mediation Role of Self-Esteem

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Sri Lanka becomes a world class apparel manufacturer supplying to universal super brands for over last three decades. The competitors in the business world can easily imitate assets like technology, processes, methods etc., while the human resource is unique to the one organization to another. Apparel companies are providing attractive compensations, transport facilities, quality work place, performance based allowances etc., to their employees. When the employees are engaged and involved in organizational activities they become profitable and stay longer in the company. However, due to the various causes, employee retention is very low in the apparel sector in Sri Lanka. Thus, this study empirically evaluated the mediation role of self-esteem between the employee recognition and employee involvement of the operational level employees of apparel companies in Katunayake Export Processing Zone. Convenience sampling technique was used to gather the data from 150 operational level employees via questionnaire method. Descriptive Statistics were used to describe the basic characteristics of the data set and Correlation and Regression describe the relationships of the variables. Further, Baron and Kenny and Sobel test were used to find the mediation effect of the self-esteem. The finding suggests that employee recognition is strong positively related to self-esteem and self-esteem is strong positively related to employee involvement, which is in accordance with the prior studies. A significantly positive relationship between employee recognition and employee involvement is found and it was mediated by self-esteem. This study was recommended to develop better employee recognition program with considering the self-esteem of employee to enhance the involvement of the employee. Researchers were suggested to consider other factors like motivation, job satisfaction etc., as mediator to determine the effect between employee recognition and employee involvement for future studies.

Keywords- Employee recognition, Self esteem, Employee involvement.

An Empirical Study on the Impact of Job Rotation Practices on Employees Job Performance: Comparative Study of Public and Private Licensed Commercial Banks in Colombo District

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Job rotation is a movement of employees from one task to another at a given time period. Offering job rotation to employees in a different way has become an important strategy to enhance employees' job performance in any organization and make them more committed towards their tasks. However, there are limited empirical studies focus on job rotation and employees job performance in banking sector. Similarly, there is no consensus among scholars about aforementioned relationship. Therefore, this study was conducted as a comparative study between private and public banks in order to identify the relationship and the impact of job rotation practices on employees' job performance with reference to the domestic licensed commercial banks. Data were collected by using convenient sampling method and the sample consisted of fifty bank employees from public licensed commercial banks and fifty bank employees from private licensed commercial banks from the Colombo district. Data analysis was performed using Descriptive Statistics, Pearson Correlation analysis and Multiple Regression analysis. Results of the analysis indicated that, job rotation practices significantly and positively associate with employees' job performance in private and public banks. Multiple regression analysis discovered that cross functional job rotation is the most significant factor of employees' job performance among private and public banks. Outcomes of this study provided implications like enhancing available literature, to understand the real impact of job rotation on employees' job performance to managers which drive them to enhance the better rotational activities. This study also suggests some further research areas for future research.

Keywords: Job rotation, Employees job performance, Domestic licensed commercial banks

Influence of Visual Merchandising on Fashion Oriented Impulse Buying Behavior: Special Reference on Colombo District

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Currently, fashion has become an integral part of day to day life especially in urbanized areas. The main objective of this research is to examine the impact of visual merchandising on fashion oriented impulse buying behavior of the people in Colombo District in Sri Lanka. Secondary objectives of the study include to investigate the relationship between visual merchandising and fashion oriented impulse buying behavior and to identify the most significant visual merchandising type which influences on fashion oriented impulse buying behavior of consumers in Colombo District. The study focuses on four types of visual merchandising techniques such as window display, interior design, floor merchandising and promotional signage. Sample of 100 people were selected from Colombo District by employing convenience sampling method. Descriptive Statistics along with statistical tools such as, Correlation Coefficient and Regression Analysis Techniques were employed to analyze the data. In this study, researcher identified that there is a strong positive relationship between promotion signage and impulse buying behavior and the analyzed results interpreted that the promotional signage would be more influencing factor on the fashion oriented impulse buying behavior in Colombo District. The main results of this research demonstrate that there is a positive relationship between visual merchandising and impulse buying behavior.

Keywords: Visual merchandising, Impulse buying behavior, Window display, Interior design, Floor merchandising, Promotion signage

An Empirical Study of the Impact of Brand Equity on Consumer Purchase Decisions of Soft Drink Market: Special Reference to Youth Sector

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At present brand equity is important element to the marketing, based on consumer's attitudes on positive brand attributes and favorable consequences of brand usage. In soft drink market, people prefer to have well-known soft drink brands. Hence, soft drink companies should know the magnitude of the impact of brand equity on the purchase decisions of consumers. And none of the research done to the soft drink market regarding impact of brand equity on consumer purchase decisions. Therefore, this research was carried out with the intention of finding the impact of brand equity on the purchase decisions of the youth regarding the soft drink brands. The national youth policy of Sri Lanka defines youth as those within the age group of 15-29. The specific objectives of the study include; to investigate the impact of brand equity on purchase decisions of Sri Lankan soft drink market, to examine the relationship between each element of brand equity and consumer buying decisions on soft drinks in Sri Lanka and to identify the most influential element of brand equity on purchase decisions of soft drinks in Sri Lanka. A questionnaire based survey conducted to collect primary data from 240 young consumers by using the convenient sampling method. Descriptive Statistics along with statistical tools such as, Correlation Coefficient and Regression Analysis Techniques were employed to analyze the data. Through hypotheses testing the researcher also revealed that each element of brand equity has a significant relationship with consumer buying decisions of the youth. According to the findings of the study, "Brand Loyalty" was the most influential factor on consumer purchase decisions among the four elements of brand equity. Hence, the domestic soft drink marketers can adapt this knowledge to their marketing plans and activities to provide the offerings based on the factual consumers' needs.

Keywords: Brand equity, Consumer purchase decisions, Brand loyalty, Brand awareness, Brand association

Environmental Science

- Earth Science and Climate Change
- Environmental Assessment and Monitoring
- Bio-Assessment and Toxicology
- Soil Fertility & Nutrient Management
- Civil and Environmental Engineering
- Environment Technology and Innovation
- Environmental Pollution
- Environmental Legislation
- Water Chemistry, Water Treatment and Geochemistry

Equilibrium Isotherm Analysis of Methylene Blue Adsorption by Natural Sri Lankan Ball Clay

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Synthetic dyes are used in the textile industry production as raw materials. Excess and dye-containing wastewater are released to the environment without proper treatments. Consequently, textile wastewater creates environmental hazards. In Sri Lanka, textile industry cannot release their wastewater without treating upto industrial discharge limits stipulated by Central Environmental Authority. The main objective of this study was to Sri Lankan ball clay has been investigated as low cost and eco-friendly adsorbent for the removal methylene blue from aqueous solution. The powder X-ray diffraction (XRD) analysis was carried out to find the structure and the type of clay mineral present in the bulk clay sample. Batch system experiments were carried observing an effect of the adsorbent dosage, contact time and initial concentration. Equilibrium isotherm of the clay materials was studied Freundlich and Langmuir model. According to the results of the influence of adsorbent dose, the removal percentage and adsorption capacity almost became constant at the dose of 6.8 g/100 ml. Therefore, it was considered the best dosage of adsorbent. As a result of contact time, it was found that the adsorption tends to attain the equilibrium in near 270 min (4.5 h). It was considered the saturation time. The results indicated that increasing adsorption capacity with increasing concentration. The equilibrium of the ball clay was found the Freundlich isotherm model was more suitable than the Langmuir model. Since the high value of the Freundlich correction coefficient ($R^2 = 0.9730$) than the Langmuir correction coefficient ($R^2 = 0.9266$). A conclusion is Sri Lankan ball clay can be employed as the low-cost alternative for removing the dye from industrial wastewater.

Keywords: Adsorption, Methylene blue, Ball clay, Freundlich, Langmuir

Determination of Nitrate and Nitrite Ion Levels of Drinking Water Bodies in Selected Locations at Gageyaya Village, Mahiyanganaya

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Monitoring nitrate and nitrite concentration levels in drinking water is important due to their potential toxicity and carcinogenicity. The World Health Organization's guideline values for nitrate and nitrite ion concentrations in safe drinking water are 50 mg L^{-1} and 3 mg L^{-1}, respectively. Mass cultivation using chemical fertilizers cause the ion levels in groundwater and drinking water to exceed the above accepted values. This research study was carried out to investigate the nitrate and nitrite levels in drinking water at selected locations of Gageyaya village, Mahiyanganaya, where cultivation of paddy using chemical fertilizers is in practice. Water samples from 10 drinking water wells (located amidst or in the vicinity of paddy fields), from a stream and from a lake were investigated twice a month from June to November, 2018, for nitrate and nitrite ion concentrations. The samples were prepared by filtering with *Whatman* No.1 filter paper followed by 0.22 µm filter. Ion levels were determined by Suppressor Ion Chromatograph. The nitrate concentrations ranged from 0.301 mg L^{-1} to 33.066 mg L^{-1}, which was below the permissible level for safe drinking water. However, the nitrite concentrations ranged from 0.439 mg L^{-1} to 8.024 mg L^{-1}, and exceeded the maximum permissible level in the months of August to October. Nitrites can damage human health when present even in lower levels. The unacceptably high levels of nitrites detected can origin from the leachate from paddy fields. Therefore, the use of fertilizer in paddy fields should be regulated in the investigated area, and the community should be educated about the drinking water quality.

Keywords: Nitrates, Nitrites, Ion Chromatography, Drinking water wells, Mahiyanganaya

Determination of the Adsorption of Solids and Some Selected Elements into Different Types of Clay Minerals for Hospital Wastewater

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The hospital wastewater is a greater concern because of the hazardous and toxic nature and its direct discharge will contaminate water bodies. The main objective of this study was to remove total suspended solids and some selected elements from hospital wastewater since the previous studies show that Total Suspended Solids (TSS) of the hospital wastewater is high and the existing treatment plants are not efficient enough to remove them to meet environmental standards. This study showed that the TSS was 1534 mg l^{-1} and Total Dissolved Solids was 580 mg l^{-1}. Adsorption series were prepared by adding equal weight of five different clay samples which mainly contain Montmorillonite, Kaolinite and Illite clay compositions to an equal volume (100 ml) of hospital wastewater. The clay samples were then analyzed using X Ray Diffraction pattern and for the filtrate Fourier Transform Infrared Spectroscopy was done to determine the absorption after 2, 4, and 6 weeks by filtering out 100 ml of the sample from each clay type. Total Suspended Solids were measured for the untreated sample and for the samples treated with each clay by filtering using a 45µm filter paper and taking the dry weight. Removal percentages for the sample using Illite clay for TSS and Total Dissolved Solids were 96.02% and 43.27% respectively which were reached within two weeks. As for the results the optimum clay to absorb and reduce the TSS and Total Dissolved Solids in hospital wastewater is Illite which was reached within two weeks.

Keywords: Hospital wastewater, Total suspended solids, Adsorption, Illite, Total dissolved solids

Removal of Selected Metals in Textile Wastewater Using Plant Parts of *Pinus caribaea, Manihot esculenta* and *Gliricidia sepium*

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Textile industry is one of the major contributions of every nation's economy. Metals and their compounds are indispensable to the industrial and technological development and causes a major environmental threat when released to the environment. Therefore, developing effective economical removal methods of toxic metals from industrial wastewater is important, as a replacement for costly adsorption methods of removing metal ion from textile wastewater. This research attempts to assess and compare the efficiency of low cost adsorbent materials prepared from plant parts such as roots, trunk, pith and leaves of the *Pinus caribaea, Manihot escluenta* and *Gliricidia sepium.* The removal of metal ions was carried out using synthetic textile wastewater where the effect of contact time and particle size were investigated. Textile dye contained water was added to the plant parts for three different particle sizes (<150µm, 150-500 µm and 500 µm) and remaining concentrations were measured using Atomic Adsorption Spectrophotometer after 1,3,5 and 7-day time interval. The experiment showed that the quantity of metal ions adsorbed varied with contact time, particle size and part of the plant. The order of removal of metal ions by bio sorbent is $Fe^{2+} > Mn^{2+} > Cu^{2+} > Cd^{2+} > Mg^{2+}$. Furthermore, in comparison of the three plant species *Gliricidia sepium* pith shows the highest removal percentage for metal ions of 73.06% and plant leaves of all three shows the lowest removal percentage of 45.14% for all the metal ions used. This confirmed that the plant parts that has high content of cellulosic materials had a unique role on high adsorption of metals. The results convince the high potential of *Gliricidia sepium* pith as an alternative substrate behaving as an adsorbent, for removal of toxic metal ions being an economical remediation for wastewater treatment.

Keywords: Adsorption, Metal ions, Textile wastewater, Plant species

Analysis of Pesticide Residues in Rice Cultivated in Anuradhapura District Using Multi-Residue QuEChERS Method with LC-MS/MS Detection

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Rice is the staple food of Sri Lanka and where different types of pesticides are used for paddy cultivation. Presence of agrochemical residues in human body has been identified as one of the major reasons for the chronic kidney disease with unknown aetiology (CKDu) identifying Anuradhapura as a district with a high level of risk. The aim of this study was to evaluate the level of pesticide residues available in rice in Anuradhapura district. Total of 60 rice samples were analyzed for 29 pesticide residues. The extraction and clean-up were performed using a validated modified QuEChERS method with liquid chromatography - tandem mass spectrometry *(LC-MS/MS)* detection. Twelve samples showed contamination with Pretilachlor exceeding the default European Union (EU) maximum residue levels (MRL) with significant contamination ($p = 0.005$) were observed in Mihinthale. Among the 29 pesticide residues studied, BPMC was the mostly detected pesticide residue which was in the range of 0.003-0.01 mg kg^{-1}. Further, significant contamination of Chlorpyrifos ($p = 0.003$), which was a banned pesticide, was detected in Ipalogama, and Diazinon ($p = 0.001$) was detected in Thalawa. However, the average residual levels were below the national and the Codex MRL's. Contamination from Carbosulfan exceeding the EU MRL levels were seen in two samples while Tebuconazole was the sole fungicide detected out of the 60 samples investigated however with values less than the MRL's. The highest number of contaminated samples was detected in the Nuwaragam Palatha East and Nochchiyagama while the least contamination from pesticide residues was observed in Galenbidunuwewa, Kahatagasdegiliya and Horowpothana. As a whole, 43% of the total samples either exceeded or equaled the EU MRL's for rice. Hence, the findings highlight the immediate requirement of a regular monitoring system for pesticide residues in rice and a strong national policy on safer use of pesticides in paddy cultivation in Sri Lanka.

Keywords: Pesticide residues, Rice, QuEChERS, Liquid chromatography - tandem mass spectrometry

Feasibility of using Groundwater Geochemistry in Mineral Exploration; A Case Study from Udawalawe, Sri Lanka

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The geochemistry of heavy metals and trace elements in groundwater has been a promising tool for mineral exploration over the well-recognized and practiced geochemical methods such as isotopic techniques, key elements association, rare earth elements association, multi element relationship. This research focused on using heavy metals and trace elements around a known mineral deposit to explore the possibility of their potential in mineral exploration. A total of 31 groundwater and 12 soil samples were collected around Udawalawe serpentinite outcrop exposed at Ginigalpelessa and Indikolapelessa. A combined approach was used to assess the interaction between rock and minerals with groundwater and soil at Udawalawe. The pH and electrical conductivity of groundwater were measured in situ. Concentrations of Na, Mg, K, Fe, Mn, Cu, Cr, Cd, Rb, Sr in groundwater were measured using atomic absorption spectroscopy. The Present study showed Na, K, Mg, Cr, Cu, Cd, Sr and Fe are the highest elevated concentrations in groundwater close to the serpentinite outcrop. Soil samples were analyzed using X-ray diffraction for clay mineral identification. The soils close to the mineral deposit have clay minerals such as serpentine which have directly weathered from the outcrops. The enrichment of heavy metals and trace elements in the groundwater and soil clearly indicate the interaction between the serpentinite and local groundwater regime. This observation proves the feasibility of applying heavy metals and trace elements in groundwater as a tool for uncovering subsurface mineral deposits. In order to strengthen the observation and gain a recognition, it is recommended to precise the same procedure around known mineral deposits.

Keywords: Groundwater, Geochemistry, Mineral exploration, Heavy metals, Trace elements

Risk Assessment and Health Based Evaluation on Rural Water Supply Schemes: Case Study in Kotiyakumbura, Mawela and Kandewaththa

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Provision of safe drinking water and sanitation facilities are cited as the highest social priority to communities. In Sri Lanka, rural water supply schemes are not subjected to substantial concern. This research was to focus on health-based evaluation on treated water from rural water supply schemes. Hazards and hazardous events were identified at the water source, treatment process, distribution system and the consumer end of three rural water supply schemes. The risk assessment was carried out following semi quantitative approach. 40% of the identified hazards were recorded as high risk. Turbidity, Electrical conductivity, pH, Temperature, Alkalinity, Hardness, Nitrate, total phosphate, Phosphate, *E. coli* and total coliform were measured in raw water, treated and water from consumer end. Residual Chlorine was measured in treated and consumer end water samples. Tested water quality parameters were within the limits of Sri Lankan Standards except the pH of treated water in *Kotiyakumbura*, turbidity of *Kandewaththa*. *Kotiyakumbura* and *Mawela* treated water is microbiologically unsatisfactory. The pH of water in *Kotiyakumbura* ranges between 5.98 and 7.40. 90% of the turbidity of water at the consumer end in *Kandewaththa* exceeds 2 Nephelometric Turbidity Unit. Questionnaire survey was done by covering the income levels, education backgrounds and location. *Kandewaththa* consumers do not use this water for drinking. Currently, none of the consumers are suffering from waterborne diseases. 82% of *Kotiyakumbura* and 78% of *Kandewaththa* consumers practice domestic water treatments such as boiling and filtering. Due to these domestic treatments they may be free from water-borne diseases currently. As a recommendation it is necessary to implement Water Safety Plans on rural water supply schemes. Further studies are required on rural water sector to improve the quality of treated water.

Keywords: Risk assessment, Hazards, Residual chlorine, Water safety plans

Assessment of Quality of Drinking Water in Selected Areas of Badulla District: An Approach to Causative Factors for Chronic Kidney Disease of Unknown Etiology (CKDu)

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Chronic Kidney Disease of unknown etiology (CKDu) is one of the major health issues in Sri Lanka. Though the main reason for the CKDu has not yet been identified, it is suggested that this is due to multi-factorial effect. However, it strongly correlates with certain drinking water quality parameters. Hence, this study was aimed on evaluating the quality of drinking water sources in CKDu potential areas in Badulla district and compare with the Sri Lanka Standard (SLS) water quality admissible levels. Drinking water samples were collected from dug wells in CKDu potential areas in Uva Province; Lower-*Rathkinda*, *Ginnoruwa*, *Rideemaliyadda* and *Uva Paranagama* (control area). Parameters such as pH, electrical conductivity, anions and heavy metals were analyzed following standard methods. Data were analyzed by one sample T- test, using IBM SPSS statistics 21.0 version. Mean values of pH value, electrical conductivity, chloride levels, nitrate levels and hardness of water samples of all the areas were within the acceptable range for portable water according to the standard SLS 614:2013. Mean fluoride contents and phosphate contents of all potential CKDu areas were less than the stipulated standard levels while *Uva Paranagama* exceeds the standard levels. Cadmium, as one of the most suspected causative heavy metal for CKDu, showed significantly higher level ($P<0.05$) than that of the admissible level of 0.003 mg L^{-1} in Lower- *Rathkinda* (0.005± 0.001 mg L^{-1}) and *Ginnoruwa* (0.006± 0.001 mg L^{-1}). Control area showed a higher Cd level (0.04± 0.002 mg L^{-1}, $P>0.05$) than that of the permissible level whereas *Rideemaliyadda* (0.002± 0.002 mg L^{-1}, $P>0.05$) shows lower levels than the permissible level. Lower- *Rathkinda* and *Ginnoruwa* areas showed higher levels of iron than that of the standard level of 0.3 mg L^{-1}. Due to the high content of Cd levels in all the water samples, the water sources are at a risky status for drinking purpose even though the other parameters showed safe levels.

Keywords: Chronic kidney disease, Badulla, Water quality, Cadmium

Time-efficient and Accurate Texture Analyzing Method for Tropical Soils

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Soil texture refers to the relative percentages of the primary particles in soil. It is an important property for studies in plant nutrient retention, hydrology, leaching, erosion and other processes. Texture analysis involves separation of aggregates into single grains by dispersing primary particles followed by fractionation. Among different methods of analyzing soil texture, pipette method is considered as the most accurate. However, lengthy pre-treatment procedures of pipette method are considered as a main reason for the laborious nature of soil texture analysis. This study compares two variants of pipette method in view of selecting a time-efficient method without compromising the precision and accuracy of assessment. The International Soil Reference and Information Centre (ISRIC) method involves a lengthy pre-treatment procedure which assures a better accuracy and precision. Comparatively, the Kellogg Soil Survey Laboratory (KSSL) method is less time and chemical consuming. Thirteen soil samples representing a range of soil textural composition were analyzed using both procedures. Coefficient of variation (CV) values of sand (0.22), clay (0.42) and silt (0.44) of KSSL method were similar to the CV values of sand (0.19), clay (0.47) and silt (0.33) of ISRIC method indicating comparable precision of the KSSL method. Pearson correlations analysis revealed high correlations for sand (0.99), clay (0.91) and silt (0.72) measured using two methods indicating strong resemblance of analytical results. A very low root mean square error (sand 4.4%) of KSSL method further indicated similarity of analytical results. This was further shown by two sample T-test results with no significant difference ($p<0.05$) between average sand, silt and clay percentages of two methods of soil texture analysis. Therefore, the KSSL method can be recommended as a time and cost effective method over the ISRIC method for soils of Sri Lanka for analyzing texture.

Keywords: ISRIC method, KSSL method, Pipette Method, Pre-treatment, Soil texture analysis

Awareness on E-waste: A Case Study in Faculty of Arts, University of Colombo

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E-waste is the popular informal term for e-products nearing the end of their useful life and it has silently become one of the growing segment of our national waste stream. E-waste can be defined as all secondary electronic-electrical appliances whether sold, donated, obsolete or broken. Migration from analogue to digital technology has influenced the replacement of new e-products and it also has intensified the growth of discarded electronic-electrical appliances as e-waste. The objectives of this study were to identify the consumption pattern of e-gadgets, the different modes of exposing e-waste into the environment and the level of awareness regarding the impacts of e-waste among special degree undergraduates of faculty of Arts. The study was conducted in the Faculty of Arts, University of Colombo as a case study, Out of 360 second year special degree undergraduates, 40 undergraduates were selected through the purposive sampling technique, structured questionnaires and two in-depth interviews to collect primary data. Results revealed 90% of respondents were known about e-waste before. According to the data outcome 42.5% of respondents claimed that Social Media were the key source of information about e-wastes. Though respondents have awareness about e-waste in various degrees the majority of both male and female respondents 95% were not much aware about the e-waste collecting bodies in Sri Lanka. When considering the health impacts of e-waste 65% of respondents were conscious about health impacts of e-wastes but 12.5% have reported that they were not totally aware of it. The awareness on e-waste among second year special degree undergraduates of the faculty of Arts is critically high, and the impact of social media as a source of information about e-waste has been a key factor of awareness regarding e-waste for them.

Keywords: E-waste, Social-media, Electronic-Electrical appliances, Awareness, Consumption

Removal of Heavy Metals from Industrial Wastewater through Minerals

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Heavy metals are toxic to health and environment and causes harmful outcomes to the human beings. It is essential to take effective endeavors to remove the metals from contaminated water. In this research, naturally available brick materials with different compositions collected from Kandy (type A), Gampaha (type B), and Embilipitiya (type C) areas were used to remove Cu, Cr and Pb ions. These brick materials are cost effective and readily available alternative to conventional heavy metal removal. The characterization of brick materials is performed using X-Ray Fluorescence (XRF) and Nitrogen Adsorption – Desorption analyser. Calculated surface area and total pore volume and pore width of type A, B, and C are lie respectively, in the range of 128-154 m2/g, 0.24-0.45 cm3/g, and 5.6-16.7 nm. Main objective of this research is to investigate how the characteristics of adsorbents influence the adsorption process and identifying the best model to describe the kinetic and equilibrium adsorption to purify the metal contaminated water. Results indicate that Pseudo – first – order kinetics model properly described the adsorption of Cu2+ to the brick type C, which has maximum adsorption capacity of 497 mg g-1. The adsorption process of Pb2+ to the brick type A and Cu2+ and Pb2+ to brick type B and C were well-fitted with Pseudo – second – order kinetics model. In equilibrium studies, Langmuir isotherm showed a better fitness in adsorption of Cu2+ into brick type A and C, Pb2+ into brick type B, whereas Freundlich isotherm well represented the adsorption characteristics of Cu2+ into brick type A, Pb2+ into brick type B and Cr6+ into all brick types. The comparison results indicate that the use of brick types A, B, C can be used as potential nan sorbents to remove heavy metals from industrial waste waters.

Keywords: Heavy metals, Minerals, Adsorption, Specific surface area, Ion concentration

Study of Applicability of Kaolin to Remove Heavy Metals (Cr, Mn, Cu, Fe and Cd) from Textile Sludge

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Synthetic dyes (metal complex, direct, azo, vat etc.) heavily used in the dyeing process in textile industry are toxic as they contain a wide variety of poisonous chemical compounds including carcinogenic heavy metals that cause adverse effects on all forms of life. In textile wastewater treatment process, most of these chemicals get settled out, ending up in sludge making it hazardous, thus making its management a critical environmental issue. Studying the effective utilization of compost and kaolin mixtures with 0, 10, 20, 30 and 40 wt% kaolin to compost mass ratios on textile sludge (in the form of a slurry) treatment and to analyzing their efficiencies at specified heavy metal(s) removal under ion exchange and absorption processes is the primary objective of this research. In the study adsorption characteristics were provide by adding kaolin and compost for boosting Cation Exchange Capacity (CEC) of filter media(s). Major physical changes were observed in the media after 50 days at which filtering process was terminated. Higher average values for all analyzed parameters; Cr, Mn, Cu and Cd in textile sludge used for the experiment was reported. Wide ranges of removal efficiencies in all heavy metals: Cr (9-67%), Mn (2-100%), Cu (6-98%), Fe (1-100%) and Cd (16-95%) was observed where heterogeneous sorption processes were involved. In addition, the statistical analysis revealed that a significant improvement in removal efficiencies of all specified heavy metals can be achieved by adding organic matter to kaolin except for Mn. It was concluded that the filter with 30 wt% kaolin/compost has the best conditions. Furthermore, X-ray diffraction (XRD) analyses indicated that secondary mineral kaolinite as the major mineral responsible for the sorption process. Fourier-transform infrared (FT-IR) analysis of filter media(s) evident active functional groups for sorption.

Keywords: Kaolin, Organic matter, CEC, Sorption processes

Contamination of Drinking Water by Solid Waste Leachate: A Case Study in Badulla Municipal Council, Uva Province, Sri Lanka

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The most common municipal solid waste disposal method in Sri Lanka is open dumping primarily due to the lack of financial assistance, operation technology, and maintenance facilities. The studied municipal solid waste dumpsite is located in the *Badulla* city, where *Badulu Oya* (River) flows surrounding the dump site. The pollution potentials of river water due to leachate from the *Badulla* dumpsite have not been studied. The main objective of this study was to assess the contamination of drinking water by solid waste leachate of the Badulla dumpsite. Water samples from river water (RW), tap water (TW) and groundwater (GW) were collected within a 300 m distance from the dumpsite during the period of May to August 2018 at monthly intervals with three replicates. In parallel to water samples, leachate samples (L) were also collected from the dumpsite. All water samples and leachate samples were analyzed for pH, electrical conductivity (EC), Turbidity, total dissolved solids (TDS) and some selected heavy metals of (Cd, Cr, Ni, Cu, and Fe). The measured water quality parameters were plotted and compared with the drinking water quality standards of WHO and SLS 614 guidelines. The results obtained from this study showed that the leachate generated from the municipal solid waste dumpsite had an impact on GW quality. According to this case study, parameters such as EC, Turbidity, TDS, Cr, Ni, and Fe have exceeded the SLS 614 water quality standards for GW and RW. On the other hand, TW did not show any contamination levels mainly due to the purification process by the National Water Supply and Drainage Board. Further studies are needed to evaluate the spatio-temporal variation of water quality parameters representing annual variation at different locations of the river and groundwater.

Keywords: Open dumping, Solid waste, Leachate, Water pollution

Product Carbon Footprint of a Garment Manufacturing in Sri Lanka.

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Apparel sector contributes for 5% of the total greenhouse gas (GHG) emission in the world. In Sri Lanka, apparel industry is one of the biggest industries which provide significant contribution to the growth of national economy. As denim production is a major subsector in this industry, estimating carbon footprint (CFP) of the pair of denim jeans is very much important. Therefore, main objective of this study is to assess the CFP of a branded pair of denim jeans manufactured in Sri Lanka for the export market. A process map was built considering on activities and processes that contribute to the life cycle of pair of denim jeans. The cradle to gate system boundary was defined to determine the product CFP. Activity data were collected from bills, data recording sheets, running charts and personal communication. Emission factors were obtained from the database of the Department for Environment, Food and Rural Affairs of United Kingdom (DEFRA). Calculation of CFP was done based on life cycle analysis under PAS 2050. Result showed that CFP of a pair of denim jeans is 18.41 kgCO_2e. According to the energy usage in stage of garment manufacturing, CFP for biomass, electricity and fuel were 9.42%, 4.32%, and 0.09% per product respectively. The highest carbon emission was recorded by fabric production (48.88%) while transportation (18.95%) and garment manufacturing process (16.41%) accounted for the second and third largest emissions. The lowest CFP in the production process showed for cotton production (15.75%). Finally, it can be concluded that there are provisions to reduce CFP of a pair of denim jeans manufactured in Sri Lanka using organic cotton, renewable energy sources and other environmentally friendly manufacturing methods. However, CFP of this product is comparatively lower than the estimates of other countries.

Keywords: Carbon footprint, Denim manufacturing, GHG, Sustainable production

Application of Newly Develop Bacterial Consortium for Decolorization of Structurally Different Textile Dyes

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Sri Lanka, niche of high quality supplier of apparel to the world, produce heavy load of textile wastewater every day. Such textile dye contained wastewater is to be treated prior discharge to the environment to maintain the pollution standards. The existing physical and chemical treatments methods are highly expensive. Therefore, the present study was focused on develop a novel bacterial consortium isolated and characterized previously as textile dye decolorizing bacteria which were isolated from textile wastewater effluent sites. Selected bacterial strains were starved overnight in 0.01 M sodium chloride, equalized the suspension at A590 = 0.35 and 5% (v/v) of suspension was introduced into sterile CI Direct Blue 201 (DB) textile dye at final concentration of 50 mg L^{-1}. Standard spectrophotometric method was followed to determine the decolorization percentage. Three individual bacteria; *Alcaligenes faecalis*, *Micrococcus luteus*, and *Staphylococcus warneri* acquired 60, 64 and 72 h respectively for complete decolorization of DB dye, were selected to prepare the bacterial consortium. Decolorization of the DB dye by the bacterial consortium was completed within 48 h. It was found that the complementary interactions among three strains for rapid decolorization of DB dye than their individual effect. Decolorization of DB dye by the consortium was further enhanced under static conditions with the presence of yeast extract and glucose in the medium. Repetitive addition of DB dye to the same initial biomass showed a complete decolorization up to four cycles and descending decolorization trend was observed afterward. Further, the bacterial consortium was able to complete decolorization of selected structurally different textile dyes (Vat green FFB, Cibracorn blue, Moxillon blue) confirming their application on treatment of wide range of textile dyes by providing a greener approach to Sri Lankan textile dyeing industry to fulfill 2030 Green Environment Concept.

Keywords: Decolorization; Textile dye; Bacteria Consortium, Bioremediation

Potential of Normalized Difference Vegetation Index Derived from Multispectral Optical Satellite Imagery to Estimate Stand Basal Area and Biomass of Mangroves

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Normalized Difference Vegetation Index is one of the frequently employed vegetation index in research which utilizes the information extracts from optical satellite images and often shows significant relationships with many forest structural attributes. The present study was conducted at mangrove forest located in Vidattaltivu nature reserve, Mannar, Sri Lanka to evaluate the suitability of Normalized Difference Vegetation Index to estimate and map vegetation structural attributes of mangroves. A total of forty quadrats (100 m^2) were placed at different distances from the seaward side. Diameter at breast height was measured in trees in each quadrat and stand basal area was calculated. Above-ground and below-ground tree biomasses were estimated using already available common allometric equations for mangroves. Multi-spectral image of Landsat 8 Operational Land Imager was obtained and the image was radiometrically corrected. Subsequently, Normalized Difference Vegetation Index was computed and regression models were developed. Best fit models were selected to estimate and map stand basal area, above-ground biomass and below-ground biomass of mangroves. Field sampling method resulted average values of 22.25±9.06 m^2 ha^{-1}, 205.18±98.66 t ha^{-1} and 86.54±39.26 t ha^{-1} while remote sensing method generated average values of 22.64±3.75 m^2 ha^{-1}, 197.46±37.81 t ha^{-1} and 85.54±14.99 t ha^{-1} for stand basal area, above-ground biomass and below-ground biomass respectively. Maps generated through remote sensing method manifested their potential in interpreting mangrove structural attributes effectively and efficiently with respect to field based techniques where the sampling process is rather a difficult task with relatively high time and monetary demands.

Keywords: Vegetation indices, Landsat 8, Mangroves, Vidattaltivu

An Eco-friendly Approach to Purify Reject Water from Reverse Osmosis Treatment Plant

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The usage of Reverse Osmosis (RO) treatment plants has been increased worldwide with the increasing demand for safe drinking water. The waste water consists of potential contaminants rejected from the RO treatment, referred as RO reject water. Purifying RO reject water before releasing into the environment is one of the challenges faced by industries. The study focuses on phytoremediation technology where aquatic plants have been used to absorb contaminants in RO reject water. The water hyacinth (*Eichorrnia crassipes*) and water lettuce (*Pistia stratiotes*) were selected as floating aquatic plants. The change in water quality before and after being exposed to plants and phytoaccumulation capacity of plants after eight weeks were investigated in the study. The contaminants of RO reject water including iron were successfully removed by aquatic plants within first four weeks (phase I). A higher reduction in concentration of total hardness, calcium hardness, alkalinity and ions was identified in treatment tanks compared to control which was filled with RO product. The removal of ions decreased with time within phase I, except for chloride and calcium hardness. Although, the removal of total hardness, chloride, iron, magnesium, potassium and sodium in RO reject water was significantly ($p < 0.5$) greater in treatment tanks after first two weeks, only total hardness, alkalinity, iron and sulphate removal were significantly ($p < 0.5$) higher compared to control with the period of exposure to plants within phase I. However, capacity of plants to reduce contaminants of water was not detected in second four weeks. Both aquatic plants accumulated ions in their biomass especially with a higher accumulation for magnesium, sodium and potassium compared to control. Therefore, the proposed water treatment system can be used to treat RO reject water, with regular harvesting of plants and new replacement at every four weeks to maintain the effectiveness of phytoremediation process.

Keywords: Reverse osmosis, RO reject water, Phytoremediation, Phytoaccumulation capacity, Floating aquatic plants

Design and Development of a Double Layered Compost Biofilter for Ammonia Odour Filtration in Broiler Farms

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Odour emission from deep litter broiler farming is a serious health and environmental issue that may hinder the widespread application of broiler farming in urban areas. Biofiltration with organic biofilters has been identified as affordable technology for odour filtration. In this study, a prototype composite biofilter having 400 mm diameter, 75 mm thick wet and dry matured compost layers were fabricated using steel and polyvinyl chloride pipes. The odorous gases from a broiler unit at Livestock Field Station, University of Peradeniya, having 12 m^2 space and 200 birds was filtered through the developed biofilter for two weeks. The odorous gas containing 2.8 ppm of Ammonia was sent through the filter at a rate of 1.5 $m^3 min^{-1}$ while maintaining the moisture contents of the beds at 30% and 40%. The biofilter system was operated continuously while evaluating the performance through measuring ammonia concentration in inflow, outflow and between layers. The results revealed that, Ammonia removal efficiency was 99% during 14 days of experiment period. The volatile solids and C/N ratio of bed media were gradually declined due to higher microbial activity in wet filter layer. Furthermore, a sensory evaluation was done by using 30 individuals to estimate the effectiveness of the treatment and found that odour intensity of outlet air is significantly lower ($p<0.05$) than that of inlet air. Thus, it was concluded that the compost based double-layer biofilter system is an effective and economical technique for odour removal from the broiler farms.

Keywords: Biofiltration, Broiler farms, Compost, Odour

Wastewater Treatment Solution for Vehicle Service Stations by Using Ultrafiltration Membrane

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A vehicle service station is place where large amount of water is consumed for vehicle washing. This wash water includes contaminants which may cause adverse effects if not treated properly before discharge. Many treatment methods have been suggested by researchers to treat service station effluent. These treatment methods have drawbacks such as large space requirement, high chemical consumption, sludge production, not user friendly compact systems. With that the need for improved techniques to purify contaminated waters arises. Over the past decennia membrane technology has been introduced as a cost effective method to treat water in a smaller foot print. Therefore, a prefabricated membrane reactor using Ultrafilters was introduced to study the effectiveness of removing contaminants from service station wastewater. The treatment process included an oil trap and then the membrane reactor which included a sand filter, carbon filter and a micron filter as the pretreatment steps for the Ultrafilter. As analyzing part, the characteristics of wastewater for parameters such as pH, total suspended solids, oil and grease, biochemical oxygen demand, and chemical oxygen demand were measured in the raw water, oil trapped water and water sent through the membrane reactor. In the absence of any specific discharge standard, the outlet water quality was compared with the Sri Lankan standard for discharge of effluents to inland surface waters. The treatment process was able to keep the parameters within the tolerance limit values of the standards by removing 91.46% of total suspended solids, 98.8% of oil and grease, 78.71% of biochemical oxygen demand and 93.32% of chemical oxygen demand. As a result, this water can be safely discharged into the environment or can be taken into reuse purposes.

Keywords: Effluent, Membrane technology, Ultrafilter, Pretreatment

Characterization of Effluent Water from Dairy and Meat Processing Industry in Sri Lanka

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Industrial wastewater entering a water body represents a heavy source of environmental pollution. Wastewater from food industries causes pollution problems due to its high Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Compared to other industrial sectors, food industry requires great amounts of water. The main environmental problem of the food industry is that the wastewater resulting from their activities does not meet the limits of the environmental regulations for the discharge of wastewater to the environment. The main objective of this study is characterization of wastewater from dairy and meat processing industries in Sri Lanka through analysis of physical and chemical parameters (BOD, COD, pH and electrical conductivity). Wastewater samples were collected from three dairy and meat processing companies at different days and 3 replicate measurements were taken from each sample. For all the analysis, APHA methods were followed. Ranges of BOD, COD, pH and electrical conductivity of wastewater respectively were 111.33±5.51-1303.30±12.70 mg L^{-1}, 1616.70±57.70-6400.00±229.00 mg L^{-1}, 5.30±0.12-7.70±0.12 and 0.39±0.01-1.78±0.01 Sm^{-1} in dairy industry and 134.33±2.31-1206.70±58.60 mg L^{-1}, 3017.00±231.00-12720.00±0.01 mg L^{-1}, 6.60±0.15-9.69±0.03, 0.43±0.01-2.44±0.02 Sm^{-1} in meat processing industry. Physicochemical properties of wastewater all mean values among dairy and meat processing industry were significantly different ($p<0.05$). The study also showed that wastewater from meat processing industry had a higher BOD and COD compared to that from dairy industry. Further, BOD and COD showed no linear relationship with pH and electrical conductivity ($p<0.05$) and there may be nonlinear relationship between BOD, COD and other parameters. The dairy and meat effluent has excess BOD and COD than the limits of environmental regulation (p value<0.05), therefore, suitable treatment process and dilution process is required before discharging to the environment.

Keywords: Wastewater, Biochemical oxygen demand, Chemical oxygen demand, Dairy, Meat processing industry.

Assessment of Phytoremediation to Treat Selected Metals in Textile Wastewater

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Textile wastewater causes aquatic pollution and is toxic to both human and animals. The existing conventional treatment methods ultimately add heavy metals to the sludge making it unsuitable for future usage. Hence, there is an urge for an environmentally friendly, cost effective technological solution to treat textile wastewater to remove heavy metals prior to discharge to the environment. Thus, the present study describes the application of phytoremediation to remove metal pollutants from contaminated soil and water. This work aims to compile information on the removal efficiency of four different types of plants (*Canna indica, Ipomoea aquatica, Monochoria vaginalis and Liminocharis flava*) on five different types of metal pollutants (Mg, Cd, Cr, Cu and Mn) in textile wastewater. The plants were grown in soil media, where the initial concentrations of the metals were known, and a synthetically prepared textile wastewater was kept in contact with the plants for two weeks. The measurements were done after 1, 4, 7 and 10 days, where concentrations of metals were measured using Atomic Absorption Spectrophotometer. Results showed that *Monochoria vaginalis* and *Liminocharis flava* plants started to die after four days from the commencement of the study showing their incapability in phytoremediation, while *Canna indica* and *Ipomoea aquatica* showed growth characteristics. The overall removal efficiency of Mg, Cd, Cr, Cu and Mn by *Canna indica* were 90.32, 88.42, 85.33, 85.08 and 23.15%, respectively, whereas removal efficiency by *Ipomoea aquatica* were 89.88, 83.74, 82.49, 80.17 and 11.27%, respectively showing similar absorptions for both plants. The study concludes that the *Canna indica* is the best plant among the selected plant types for the removal of the chosen metal pollutants. *Ipomoea aquatica* was found to be the second highest effective plant which also signifies that, contaminated plant can cause health issues by consuming it as a food.

Keywords: Phytoremediation, Textile waste, Atomic absorption spectrophotometer, Sludge treatment

Assessment of the Impact of *Azolla pinnata* at Demodara Water Treatment Plant Intake Reservoir

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Demodara Water Treatment Plant intake reservoir is located in between Demodara and Badulla cities about 12 km upstream in Badulu Oya from Badulla. An invasive growth of floating macrophyte was observed from third week of January 2018. Water quality of treatment plant intake reservoir was studied by analyzing the reservoir water with the presence and the absence of the *Azolla* mat, to find whether there was any change in the water quality with the mat. Water quality close to the dam, lake at about 1 km upstream from the dam and upstream flowing water (about 500 m upstream from the lake) were analyzed in different depths (close to the dam 6.5 m and upstream lake 1 m depth). pH, turbidity, electrical conductivity, dissolve oxygen was analyzed on site and NO_3^-, Total PO_4^{3-}, SO_4^{2-}, Cl^- and F^- was measured using Ion Chromatograph and relative abundance of phytoplanktons were estimated using plankton nets (20 μm) and microscope with the presence of *A. pinnata* mat and following day of removal of *A. pinnata* mat. As a part of the study, two models were observed inserting 20 l of intake reservoir water and 22 g of *Azolla* for one model. pH, turbidity, conductivity was monitored for seven weeks. pH was decreased in the model with *Azolla*. Conductivity and turbidity did not show a significant change. pH decrement and Total PO_4^{3-}, Phytoplankton increment was observed with the absence of the mat in Demodara reservoir. All the water quality parameters in treatment plant raw water were within the drinking water standards (SLS 614:2013), with the presence of *Azolla* mat. The *Azolla* didn't appear after manual removal. Therefore, further studies and implementing a Water Safety Plan by proper catchment management is needed.

Keywords: Floating macrophyte, *Azolla pinnata*, Phytoplanktons, Plankton nets, Water safety plan

Variation of Phytoplankton in Relation to Some Environmental Factors in Kandy Lake, Sri Lanka

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The Kandy Lake is a freshwater ornamental water body located in Kandy. Anthropogenic activities on surrounding catchments of the lake may result different physicochemical conditions leading to severe environmental issues. Physicochemical parameters play a main role in determining the distribution of phytoplankton resulting them as biological indicators in environmental studies. The current study was focused on investigating the phytoplankton diversity, abundance and their ecology in Kandy Lake. Both physicochemical and biological parameters were measured by monthly from February to July 2017. Biological samples were collected using 34µm plankton net and analyzed the diversity and abundance, according to the standard procedures. Environmental parameters such as temperature, pH, conductivity, total dissolved solids, dissolved oxygen, nutrients and some ions were obtained by field and laboratory analyses. Data were analyzed using Microsoft Excel (2007 version), CANOCO for windows (v.5) and SYSTAT. Results revealed that the highest species richness was represented by the class bacillariophyceae (66.65%). *Aulacoseira granulata* was the widely distributed species with highest relative abundance (66.24%). The dominance of *Aulacoseira granulata* is an indication of high organic pollution of the water body which in turn indicates the eutrophication. Among the toxigenic cyanobacteria, *Microcystis* sp. was the widely distributed species. Kandy Lake has developed into a victim of eutrophication recently, causing accelerated growth of *Microcystis* sp. leading to formation of blooms. According to Canonical Correspondence Analysis, nitrate and dissolved oxygen were the most important environmental factors in explaining the distribution of phytoplankton in the lake. Findings of the present study suggest that Kandy Lake may not be in a position to sustain the aquatic life in the future.

Keywords: Kandy lake, Phytoplankton, Environmental variables, Eutrophication

A Study of Portable Drinking Water Supply in Bibile Divisional Secretariat Area

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This study area covers villages belongs to the Bibile Divisional Secretariat Division (DSD) in Monaragala district closer to the western margin of the Uva province. The area consists of 40 Grama Niladari (GN) Divisions which lies around the Bibile DSD. Due to severe drought periods experiencing in every year, the people in Bibile have to face many difficulties to obtain drinking water. The objective of this study was to assess the portable drinking water supply in the Bibile DSD area. The primary data for this study were collected by using questionnaires, provided information by the National Water Supply and Drainage Board (NWSDB), DSD office and GN's. The DSD annual reports and Censes Department's reports were used to collect the secondary data. The water demand requirement per day was estimated based on the forecasted populations. There are two pipe borne water supply schemes (WSS) currently functioning within the area. One is operated by the NWSDB and the other is operated by Bibile Predesiya Saba. These two WSS cannot cater the total demand of this area due to limited capacities of the schemes. There are 17 numbers of rural WSS which are managed by community based organizations (CBOs) in this area and covering 7,019 people. Only 17% public satisfied with existing WSS. The water demand for the Bibile DSD for the year 2020 is estimated as 6,520 m^3 per day. The forecasted water demand by the year 2040 is 8,696 m^3 per day. The total water demand including average industrial and commercial consumption of about 12% of the domestic demand. In year 2020, the people in Bibile will only full filed about 13% of their portable drinking water requirements. Thus, people in the suburbs of the area face severe difficulties in satisfying their drinking water requirement. All of these WSS are operate in partial treatment. Hence, water quality of the WSS are not up to standard during the rainy days as per survey done.

Keywords: Water supply, Pipe borne, Water demand

Impacts of Southern Expressway towards Flood Condition Changes: A Case Study in Dodangoda Divisional Secretariat.

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Road infrastructure can be considered as a backbone in terms of both passenger and freight transport. With the construction of expressways, it contributes to undoubted social and economic development of a country. Southern expressway is the Sri Lanka's first expressway experience and now it is under expansion stage. Though people emphasis the positive influence, it is worth to mention the negative impacts of expressway construction. Hydrology and drainage changes, water quality and quantity changes, air quality and vibration impacts, habitat fragmentation and direct mortality of animals are determined as examples for negative impacts. Frequent floods even in small rainfalls are common around the expressways now. This paper elaborates changes in flood condition of the study area due to expressway construction. Field questionnaire survey for 63 families was conducted on the flood affected people who surrounded the expressway in selected Grama Niladhari Divisions within study area. Survey reveals that expressway is acting as barrier for the free flow of water in flood conditions and new flood inundated areas are created as a result. The data shows 89% of the people along the 400 m road strip are experienced changes of flood conditions after the expressway construction. Improper culvert construction, poor maintenance, previous drainage pattern changes, and wetland fillings are altered flood conditions along the expressways. Thus, suburbanization of lands along the expressway has created impervious land layers by increasing runoff and finally creating urban floods. However, more environmental considerations are needed in order to promote sustainability in constructions. Although we are unfamiliar, some countries such as USA are considered their ecological sustainability even by green road rating systems. Therefore, it is timely requirement to concern those impacts in constructing expressway network in Sri Lanka since already we have faced number of troubles due to unsustainable constructions.

Keywords: Ecological sustainability, Floods, Negative environmental impacts, Southern expressway

Seasonal Solar Power Generation Potential for Electricity Supply in the Dry Zone of Sri Lanka

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Solar radiation is an important climate element and the largest energy input in the world. Sri Lanka is largely dependent on thermal energy and hydropower for its electricity needs. The solar radiation is the most abundant natural energy and it has great potential to meet the energy requirement of Sri Lanka. Solar-powered photovoltaic (PV) panels convert the sun's rays into electricity by exciting electrons in silicon cells using the photons of light from the sun. Being located close to the equator with the benefit of having sunlight for more than 12 hours per day, using solar systems to generate electricity is truly beneficial for the country. The main objective of this study was to calculate the seasonal solar radiation flux in the Dry Zone of Sri Lanka. The daily solar radiation data was collected by the Silicon Pyranometer for the period from July 2009 to June 2010 from the automatic weather station at Mahailuppallama Agro-Meteorological station. According to the daily average figures, the lowest average daily solar irradiance of 12.6 MJ m^{-2} was received in the month of December, whereas the highest average daily irradiance of 21.7 MJ m^{-2} was received in the month of March. According to the seasonal records, the highest solar radiation of 21.4 MJ m^{-2} received during the First Inter-Monsoon period from March to April and in the South West Monsoon from May to September shows also reasonably high solar radiation of 19.3 MJ m^{-2}, because this period, the airflow generally flows from southwest to northeast direction with less moisture to the Dry Zone. The Second Inter-Monsoon from October to November, solar radiation was recorded as 17.0 MJ m^{-2} and in the North East Monsoon period from December to February, the solar radiation was recorded as 16.6 MJ m^{-2}. North East Monson is a climatologically rainy season in the Dry Zone because incoming solar radiation and rainfall are associated with low solar insolation. The study shows that there is a high potential for solar power generation in the Dry Zone of Sri Lanka. The establishment of the solar power plants in the Dry Zone can make a significant contribution to the National Grid of Sri Lanka.

Keywords: Dry zone, Electricity, Potential, Seasonal, Solar power generation

Processing of a Novel Low-Cost Adsorbent by Co-granulation of Egg-Shells and Tea Waste

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In this work, egg shells and tea waste were used during the co-granulation process with different mass fractions for the production of low cost efficient adsorbents to remove Methylene Blue (MB) from aqueous solutions. The main aim of this research was to process novel low-cost adsorbent by co-granulation of egg shells and tea waste. Specific objectives were to optimize color removal conditions by varying different mixing ratios of tea waste and egg shell and pH, to develop adsorption isotherm and adsorption kinetic model. Seven types of co-granules were produced by mixing mass fractions of tea waste and egg shells as 1.0:0.0, 0.8:0.2, 0.6:0.4, 0.5:0.5, 0.6:0.4, 0.8:0.2, 0.0:1.0 respectively. UV/Vis spectrometer (DR6000-HACH®) was used to measure concentrations. Maximum wave length of MB was 665nm. The adsorption data were fitted to Langmuir and Freundlich isotherms and adsorption parameters were determined using Newtons least square method. Equilibrium concentration data were fitted to the Langmuir isotherm model with high R-square value than Freundlich isotherm model. Therefore, Langmuir isotherm is the best fitted model for this adsorption process. Type 1 (tea to egg shell ratio is as 1.0:0.0) granules showed the maximum adsorption capacity. For type 1 co-granules, the Langmuir constants q_m and b were determined as 0.21 mg/g and 6.73 L/mg and Freundlich constants K_F and (1/n) were 0.16 ((mg/g) (l/mg)$^{0.49}$) and 0.26 respectively. When mass fraction of tea waste increases, density decreases and specific surface area increases. Pseudo first order kinetic model is best for some types of co-granules and second order kinetic model is best for other types. When pH of initial solution increases, adsorption capacity increases. The zero-point charge (pH_{zpc}) for tea waste was determined around 5.0. Surface of tea waste is negatively charged at higher pH values creating electroststic attraction between negatively charged surfce and MB cationic ions.

Keywords: Co-granulation; Egg shell; Tea waste; Methylene blue

Seasonal Groundwater Quality Variation in Monaragala District of Sri Lanka

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Sri Lanka is divided into three climatic zones namely; 'dry', 'intermediate' and 'wet' based on the mean annual rainfall. *Monaragala* district in the *Uva* Province, lies within both dry and intermediate zones. Agriculture is the main livelihood of rural people in this area and paddy is the major crop. Paddy is cultivated in; "*Maha*" and "*Yala*" season which are associated with two monsoons *i.e.* "north-east monsoon" and "south-west monsoon", respectively. Inorganic fertilizer is commonly applied by farmers to overcome the nutrient deficiency in permanent agricultural lands. However, excessive fertilizer application can cause severe environmental and health problems. Since groundwater is the main source for drinking water in this area, this study attempted to assess the seasonal variation of physico-chemical properties of groundwater. Samples were collected from 44 sampling points representing dug and tube wells which are closely located to the agricultural fields. A total of 88 groundwater samples were collected in both seasons. The collected samples were analyzed for pH, Electrical Conductivity, Total Dissolved Solids, Total Alkalinity, Total Hardness, HCO_3^-, Cl^-, SO_4^{2-}, NO_3^-, PO_4^{3-} and F^-. A student's t-test was carried out to evaluate the seasonal effects on groundwater quality. The groundwater in both seasons is characterized by $HCO_3^- > Cl^- > SO_4^{2-} > NO_3^- > F^- > PO_4^{3-}$ facies. As per the statistical analysis, only pH, NO_3^- and PO_4^{3-} showed significant seasonal variation ($p < 0.05$). About 40.9% and 31.8% of groundwater samples are very hard, while 22.7% and 18% of are brackish in *Maha* and *Yala* seasons, respectively. Higher NO_3^- and PO_4^{3-} levels in *Maha* season (the main cultivation season) potentially show the effect of fertilization on the groundwater quality. However, the proceeding of this assessment for several consecutive seasons would be more effective to identify the seasonal variation and agricultural effects (inorganic fertilization) on groundwater quality.

Keywords: Agriculture, Fertilization, Groundwater, Seasonal variation

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Hardness Removal from Drinking Water Using Inorganic Ion Exchange Resin- Zeolite

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The hardness of drinking water has become a major environmental problem at present and it has to be removed using cost effective technologies. This research focuses on using synthesized inorganic zeolite as an inorganic ion exchange resin for hardness removal. It is to be achieved by controlling the physical parameters on performance of zeolite in different hardness level of water. The research approach includes both batch and column experiments performed in laboratory condition to determine optimum level of zeolite on the removal process of Ca^{2+} and Mg^{2+} from water. A Batch contact time experiment was carried out with varying contact time for 10 g L^{-1} of a constant adsorbent mass at the concentration of 250 ppm for both Ca^{2+} and Mg^{2+}. One hour was the optimum time. Accordingly, the experiment was carried out by varying adsorbent mass for different hardness level of Synthetic Hard Water (SHW). The different hardness level of water samples was reduced by 80-95% from 3-5 g dosage of zeolite. The data obtained from the batch adsorption system is not applicable for design a continuous adsorption system. Then, column sorption studies were carried out using fixed bed column, which was filled with sand and zeolite, mixed in 1:1. The influent flow rate and concentration of the SHW solution were kept constant at 12.7 mL min^{-1} and 100 ppm, respectively. The column was reached exhaustion after the 30 min, according to the breakthrough curve for the column. According to results, it can be concluded that synthetic inorganic zeolite can be used to remove hardness from all the hardness range of moderately hard water, hard water and very hard water in high percentage (80-95%).

Keywords: Hardness, Synthetic hard water, Synthetic zeolite, Continuous adsorption

Urban Green Infrastructures as an Integrative Approach for Sustainable City Planning and Development in Sri Lanka

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Sustainable urban planning and development denotes the quality improvement of life through engineered environmental, social and economic constituents concerning the life standards of future generation. Population density within Sri Lanka's capital; Colombo, is higher as 18,900 populations per km^2 and has experienced 0.09 – 4.4^oC urban heat island effect during 2012. Since land use has been changed periodically by urbanization and industrial expansion, unplanned grey infrastructures have resulted downgraded environment with sudden natural calamities which challenge livability in Colombo city. Hence, the objective of this paper is to review the significance, present status and future perspectives of urban Green Infrastructure (GI) as an integrative approach for sustainable city planning and development in Sri Lanka. GIs are multi-functional approaches for ecological equilibration and sustainability in urban context. Rain gardens, living roofs, urban forestry and vertical gardens are few of GI that has widely been implemented worldwide. Green walls are superior in temperature reduction, air purification and energy conservation at building micro-climate. Most developed countries are strict with national planning policies concordance with environmental protection agencies, sustainable development goals and ISO 31720 standard for resilient and sustainable cities. Sri Lankan government recently paid attention on sustainable urban development with multi model transport hubs, metro Colombo urban development projects as integrated flood management systems, rehabilitation and implementation of urban public facilities. Positively, urban development authority leads future development strategies counting landscaping, traffic impact assessment and water management systems raising social awareness. However, integrated holistic city – scale approaches of GI in urban planning should be encouraged by local government through mandatory policies ensuring socio – economic benefits beside cling to certain notions.

Keywords: Green infrastructures, Policies, Sri Lanka, Sustainable urban planning

Social Impacts on Rainwater Harvesting – A Case Study in Anuradhapura and Kegalle

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Water scarcity is a global issue with the increasing population. Rainwater harvesting is considered as an environmental friendly, sustainable source of water which can be used for domestic and drinking purposes. Sri Lankan government has framed rules and policies supporting the installation of rainwater harvesting systems, however, implementation and operation of these require the acceptance and willingness of general public. This research focuses on the social impacts on the rainwater harvesting systems installed in dry and wet zones in Sri Lanka. Both, water quality (Physical, Chemical, Bacteriological) and factors affecting it were assessed through the study. The samples were collected from rainwater harvesting systems at Kegalle and Kebithigollewa regions, 30 from each while conducting a questionnaire survey simultaneously. pH values were varied between 5.53- 7.19 in Kebithigollewa and 6.49 – 9.55 in Kegalle, may be due to the reactions in the tank material, ferrocement and plastic. All the tested chemical parameters of rainwater samples were within the limits of SLS 614: 2013 guidelines. Total coliform was detected in 50% of Kebithigollewa samples and 100% of Kegalle samples, which may be due to wrong water quality and quantity management practices. Social survey analysis revealed that microbiological parameters were affected mainly by the cleanness level of roof catchment area and atmospheric conditions, such as dust in the environment. Consumers in Kegalle region hesitate to drink rainwater due to lack of confidence as a drinking source. Harvested rainwater can be of consistently high quality through the selection of appropriate catchment, storage materials and the application of post-cistern treatment. A water safety plan should be implemented on rainwater harvesting systems to identify the risks, to improve the water quality and to mitigate quality degradation. A social awareness programs can be recommended to increase the rainwater consumption and willingness.

Keywords: Rainwater harvesting, Water quality, Social survey, Dry and wet zones, Water safety plan

Spatial Distribution and Interactions of Environment Components in Galle Coastal Region and its Inter-Relationship with Resource Users

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Majority of the resources in coastal areas are open access, thus they are being poorly monitored and managed. Main objective of this study was to comprehend the current status of coastal environment and its components in Galle district in order to predict possible future problems in this region. This study covered approximately 44 km along the coastal region from Ahangama to Hikkaduwa beach. General information and features of the coastal area, habitats, and resources were recorded on satellite maps according to a predetermined scale, furthermore, GPS locations of important features were taken. In addition to that species diversity, and their coverage within the area of interest were monitored. Major problems and issues of the area were addressed through direct observations and the information extracted from local resource users. Final detailed coastal environment map of the studied region was prepared using QGIS software. According to results, sandy beaches were dominated (1 201 341.06 m^2) and only 132 787.82 m^2 area was covered by rocky beaches. Algae (*Dictyota*, *Padina*, *Halimeda opuntia*, *Sargassum*, *Valoniopsis pachynema*, *Ulva* etc.) and sea grass (*Thalassia*, *Syringodium* and *Cymodocea* etc.) beds were recorded in Ahangama, Thalpe, Mihiripena, Galle and Hikkaduwa. Highest biodiversity was observed in Ahangama region where one of major seagrass meadow of Southern coast is located. *Cocos nucifera*, *Ipomoea pes-caprae*, *Pandanus* and *Scaevola* are the most common seashore vegetation types while *Barringtonia*, *Terminalia catappa* and *Thespesia populnea* were also recorded less abundantly. Effluent canals, boat landing sites and dumping sites were an abundant sight in the study area. Beach pollution and erosion of sandy beaches were quite remarkable. Water resource users in the region are presumed to be directly affected by the effluent canals and streams carrying heavily polluted water. Over exploitation of the natural resources and the un-availability of a certain party to be responsible to make amends for the deteriorating quality of the coastal environment fail to remedy the current issues. Hence, integrated coastal zone management is required for this region and responsible governmental bodies must be integrated to achieve the common goal of sustainable use of the coastal resources which ensures equality among different coastal communities to have their fair share protecting the coastal resources for future generations.

Keywords: Galle, Coastal area, Resources, Sustainable use, Pollution

Management of Environmental Issues Associated with Small Scale Rural Water Supply Project Via Rapid Environmental Assessment (REA) Approach.

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The aim of the present study was to screen out potential environmental impacts related to provide safe drinking water to *Pallepalpita* and *Weragala Grama Niladhari* (GN) Divisions in Kegalle District, Sri Lanka. Rapid Environmental Assessment (REA) was carried out with the objective to identify and assess the environmental impacts associated with the proposed project and surrounding. Rapid Environmental Assessment was carried out using direct field observations from 05/01/2018 to 19/01/2018. Impacts that generated from project were categorized under three aspects; ecological impacts, community health and construction related impacts. Degree of impact was categorized under four categories as no impact, low, moderate and high. For each impact, mitigatory measures were suggested. Aspects with high degree of impact were not recorded, hence the proposed project has the potential of being initiated. Increased levels of noise and dust was identified as a moderate impact activity during the project. Moreover, flooding of excavations, increased soil erosion/silt runoff were identified as moderately impacting. Damage to other utilities such as roads and increased accidents and public safety issues due to construction work, material and machinery were identified as aspects with low impact. Significant impacts were not observed under the ecological impacts and community health. There was no special sensitive habitat area identified. In addition, the project area did not house any form of traditional economic and/or cultural activities. Adherence to the stipulated guidelines by Central Environmental Authority (CEA), implementation of Environmental Management Plan (EMP), ensuring the provisions in health and safety regulations under the Factory Ordinance were proposed as mitigatory measures for the impacts identified. In conclusion, the EMP of the project could be improved by incorporating mitigatory measures for the possible adverse effects during the designing, construction and operation stages of the project.

*Keywords***:** Environmental, Impacts, Rapid, Assessment, Mitigation

Effect of Catchment Characteristic on Formation of Trihalomethane along the Kelani River in Sri Lanka.

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Kelani River is the fourth longest river in Sri Lanka which starts its journey from the Sri Pada Mountain range and meet the ocean at Colombo. In upper catchment area there are plenty of tea and rubber plantation land and in down catchment there are huge number of industrial zones. Therefore, it carries more Dissolved Organic Carbon (DOC), inorganic and suspended solids. In drinking Water Treatment Plants (WTPs), can be removed mainly Total solid. As a result of remaining DOC in filtered water Disinfection by Products (DBPs) such as Trihalomethane (THM) formed after the chlorination. THM is carcinogenic. Present study aimed to investigate the effects of catchment characteristic on THM formation along the Kelani river. Water samples were collected from the WTPs located at *Seethagangula*, *Hatton*, *Maskeliya*, *Morontota*, *Ruwanwella*, *Yatiyantota*, *Pugoda*, *Biyagama* and *Ambatale*. Four THM species, Trichloromethane, Bromodichloromethane, Dibromochlomethane and Tribromomethane were measured using Gas Chromatography (GC) system and finally Total THM (TTHM) were calculated. The lowest TTHM concentration was reported in *Maskeliya* (9.34 µg L^{-1}) WTP. Catchment area is mostly covered with tea plantation in *Maskeliya* area. The TTHM concentration at *Morontota* and *Ruwanwella* WTPs were 42.96 ±7.00 µg $L^{-1}$and 65.70 ± 16.12 µg L^{-1}, respectively. The main catchment characteristic of these area is rubber plantation. However, highest TTHM value of 67.19 ± 4.50 µg $L^{-1}$was reported in Biyagama WTP which is located in highly industrialized area. Even though both *Ambatale* and *Biyagama* WTPs are located very close, TTHM value of the *Ambatale* (21.33 ± 2.41) µg L^{-1}WTP is significantly lower than *Biyagama*. However, all the recorded TTHM values were below the United States Environmental Protection Agency (USEPA) maximum contamination level of 80 µg L^{-1}. Finally, it can be concluded that THM formation is lower in tea plantation area and high in industrialized area.

Keywords: Trihalomethane, Kelani river, Water treatment plant.

Toxicity Assessment of a Commercial Product Containing D-Tetramethrin and Cyphenothrin on Ecosystem by using Butterflies as Indicator Species

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Ecotoxicology is a specialized form found in toxicology that focuses more specifically on the toxic substances and its effect on ecosystems. In Sri Lanka, over the past decade there is an increase in the use of pesticides. More importantly, the increase in mosquito borne diseases such as dengue fever have been resulted to the extensive use of insecticides to control the mosquito populations especially in urban areas. These chemicals can exert toxic effects for other non-target species including butterflies. This research was conducted to determine the toxic effects of a commercial pesticide containing d-tetramethrin and cyphenothrin on butterflies. This chemical is mixed with diesel and fogged extensively in urban areas. Butterflies were used as indicator species since they are very sensitive to the changes in the environment. The 5th instar larvae of *Tirumala limniace exoticus* (Blue Tiger) were used as the test species. The larvae used for the experiment were obtained by breeding the adult species in a butterfly cage. The larvae were exposed to 6 different formulations which included 'Aged Aerated Water' as Control, Diesel as Solvent Control and 4 increasing concentrations of the commercial pesticide (10, 100, 500 & 1000 ppm). A volume of 1µl was applied to the thorax region of the larvae (4 per each concentration). The chemical was allowed to air dry for a few seconds and observations were recorded. The larvae that were exposed to all the concentrations of the commercial pesticide including the solvent control did not manage to survive. This study concludes that the chemical has an effect on butterflies, thus on ecosystem. However, further studies including Acute and Chronic toxicity assessments must be conducted. The outcomes will be important in establishing conservation plans to protect butterflies as well as other insects that play a vital role in a balanced ecosystem.

Keywords: Ecotoxicology, Pesticides, Larvae, D-Tetramethrin, Cyphenothrin

Utilization of Sustainable Timber Materials for Innovative Green Building Solutions

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The demand for timber, as a sustainable construction material is projected to increase over the next half century with the massive development of the construction sector. Sustainable timber denotes to timber that has been harvested responsibly from well-managed, continuously replenished forests with no damage to surrounding environment. Industrial roundwood consumption, including timber, will be increased by 28% to 61% from 2010 to 2060. With mounting pressure to decrease the carbon footprint of the built environment, building designers are progressively being called upon to balance functionality and cost objectives with reduced environmental impact. Timber can help to achieve that balance. It is exciting to note that in response to the Paris Agreement (COP21), scientists proposed a range of "negative emissions technologies (NETs) in order to limit climate change to "well below 2C", three of which relate to timber and its capacity to absorb and store carbon from the atmosphere: afforestation and reforestation, building with biomass and biomass with carbon capture and storage. Timber can be regarded as the best construction material because it has following characteristics: carbon capture and storage, low embodied energy, truly renewable, durable and easily maintained, beautiful aesthetic, highly versatile, quick and simple build, good insulation, can use scrap and salvaged wood, non-toxic, humidity regulator and priceless habitats. In addition, timber has provided several other ecological services beside helping to combat climate change and being wildlife havens. They reduce the risk of flooding, drought, soil erosion and assist to stabilize and regulate weather and micro-climates. The objective of this research is to examine the global tendency of timber as a sustainable green building construction material, its present status, challenges, its impacts on the climate change and future perspectives.

Keywords: Carbon footprint, Green building, Negative emissions technologies, Roundwood

Poultry Litter Generation, its Impacts and Management Strategies in Sri Lanka – A Review

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The poultry sector has been increasing at more than 5% per annum in last 3 decades to complete the increasing demand of safer and high quality meat and eggs. This development has been go along with structural changes within the sector as industrial farming establishments, the intensification and concentration of poultry operations. The poultry sector contributed to 0.35% of national GDP which is more than 50% of total livestock sector contribution in Sri Lanka. The per capita meat chicken availability in Sri Lanka was 10 kg/year in 2017. Kurunagala, Puttalm and Gampaha districts are accounted as the highest poultry farm located districts in the country. Concentration of large amount of manure is accounted as a major environmental issue which emerged with poor manure-management practices such as burning, direct usage as a fertilizer, *etc*. Substantial amounts of nutrients such as N, P and excreted substances such as hormones, antibiotics, pathogens and heavy metals are contained in poultry manure which are introduced through feed. The limited access of land to dispose manure increases the concentration of manure at one place and results soil and water pollution. Direct application of poultry litter into crop fields releases large amount of N and some other nutrients together with pathogens and other microorganisms into the environment. The substances which are contained in the litter are broken down, immobilized or transformed to the water, soil and atmosphere. Different forms of N such as ammonia (NH_3), dinitrogen (N_2), nitrous oxide (N_2O) and nitrate (NO_3-) are emitted by manure and increase the N footprint. The surface application of poultry litter increases greenhouse gas emission and results global environmental issues such as global warming, climate change, eco system degradation, *etc*. Moreover, manure consists considerable amount of toxic metals such as arsenic, copper and zinc. Excessive amount of elements harm to crops and adversely affect on animals due to bioaccumulation. Scientists are focusing on efficient technologies to produce bio fertilizer from poultry litter to reduce the negative consequences which are caused by inappropriate poultry litter disposal methods.

Keywords: Bio-accumulation, Bio fertilizer, Global warming, N footprint,

Leachate Characterization and Assessing its Impact on Soil and Groundwater Quality of the Municipal Solid Waste Dump Site in Bandarawela, Sri Lanka

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This study was conducted at *Bandarawela* municipal solid waste dump site which 20 tons of waste are disposed daily. Up to the date no one has assessed the impact on soil and ground water quality of the site. This study aimed to characterize leachate and to analyze the quality of soil and water around the site. Physical-chemical parameters and heavy metals were measured using 12 leachate samples, 10 groundwater samples and eight soil samples. The samples were collected within consecutive three months. The resulting values for the Chemical Oxygen Demand, Phosphorus and Iron (Fe) of the leachate are above the tolerance limits for the discharge of industrial wastewater into inland surface waters. According to the results, ranges of the analyzed parameters of the leachate are pH: 5.95-8.36, Nitrate: 2-80 mg L^{-1}, Electrical Conductivity: 284.5-32500 µS $cm^{-1,}$ Phosphate: 9.9-435 mg L^{-1}, Total hardness: 200-1000 mg L^{-1} as $CaCO_3$ and Total Alkalinity: 833-49333.33 mg L^{-1} as $CaCO_3$. Electrical conductivity, Total Dissolved Solids, Hardness, Alkalinity, Chloride and Chemical Oxygen Demand showed relatively lower values with high rainfall than lower rainfall. The result also showed most of the groundwater samples were within the accepted limits for Sri Lankan Standards for potable water (2013) except for tube wells. In tube wells, Nitrate, Total Alkalinity and Manganese concentrations are above the tolerance limit and pH value is below the limit. The results indicated that the pH value of the soil samples were in alkaline nature within the range of 7.89 to 8.86. The study concludes that the leachate produced from the dump site is not suitable to release to the land surface. It is recommended to have an appropriate system for the collection and treatment of leachate.

Keywords: Municipal solid waste, Leachate, Open dumping, Groundwater

Comparison of the Effectiveness of Hydrilla, Water Hyacinth and Water Lettuce in Treating Domestic Wastewater

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The effectiveness of three aquatic macrophytes to improve the quality of domestic wastewater was evaluated. Growth of the Water lettuce (*Pistia stratiotes*), Water hyacinth (*Eichchornia crassipes*) and Hydrilla (*Hydrilla verticillata*) were inhibited in undiluted domestic wastewater. Therefore, diluted domestic wastewater series was introduced as 30%, 20% and 10% and all three macrophytes grew successfully in the diluted series. Chemical Oxidation Demand, Biological Oxidation Demand, Dissolved Oxygen, NO_3^- as N, PO_4^{3-} as P, pH, Oil and grease, alkalinity and acidity were analyzed as water quality parameters at the beginning and 3rd day, 6th day and 9th day after introducing macrophytes. All three aquatic macrophytes improved the quality up to the permissible levels of wastewater discharging during 9-day period. According to the performance of all three macrophytes, water lettuce is the most effective macrophyte for treating domestic wastewater within the shortest time period (3-day hydraulic retention time). Controls of the each dilution to which macrophytes were not introduced, the quality did not reach to the wastewater discharging permissible levels at any quality analyzed point within the 9-day period. A model was introduced to households for treating their own domestic wastewater using the findings of this study. In the model, domestic wastewater flows through a pipeline and another pipeline is connected with water to dilute the wastewater. To achieve the 30% dilution, 35 L of water should be supplied to 50 L volume domestic wastewater treating tank (0.41 m diameter, 0.37 m working depth) which contains inlet and outlet pipelines designed with baffle walls to keep 3-day hydraulic retention time. Introducing about 100 g fresh weight of Water lettuce at the beginning is sufficient to function this model. Treated water is flowing through the outlet after 3-day period and the water can be discharged to a surface water body or to the land surface.

Keywords: Domestic wastewater treatment, Hydrilla, Water hyacinth, Water lettuce

Application of Bioremediation for Treating Dye Containing Wastewater

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Synthetic dyes are extensively used in textile processing industries. About 20% of dye stuff which is used in these textile industries end up as wastewaters during dyeing and subsequent washing steps of textiles. Although there are established methods for treating said wastewaters such as chemical oxidation, ozone oxidation, activated carbon adsorption, those are not cost effective and sustainable. Use of Bioremediation by propagating the microorganisms in wastewaters is new trend for treatment of dye containing wastewaters. The objective of this research was to investigate the treatability of dye wastewater containing mixture of dyes: Telonrhodamine, Renozol yellow, Renozol navy, Novalaron blue and Methylene blue by using *microbes in yoghurt, Cow dung and hospital wastewater*. By applying said microbes in to dye wastewater samples with equal concentrations prepared as above mentioned, the variation of COD value, color of dye mixture and pH value were measured during 10 days. UV spectrophotometer (0-1500 mg L^{-1}) was used for measurement of color and COD. According to the tested results a reduction of COD and the color was observed after 10 days by 57.6%, 21.6% and 34.6% and by 78.6%, 52.9% and 63.5% in wastewaters contain *microbes in yogurt, Cow dung and hospital wastewater* respectively. The pH value didn't show any significant variation. Accordingly, to have efficient treatment of dye wastewater the microbes in yogurt was selected for further studies of treatment process optimization. Bacteria were grown with the use of 5mg of yoghurt and 50 ml of pure water in conical flask. Treatment was done at four different temperatures: 30°C, 35°C, 40°C and 45°C in an incubator at 100 rpm as per literature. The observed reduction of COD content and the color of dye containing wastewater after 10 days at four different temperatures 30°C, 35°C, 40°C and 45°C were 63.9%, 70.9%, 72.9% and 54.9% and 82.4%, 85.1%, 86.5% and 74.6% respectively. Therefore, it could be decided that the reduction of COD and color will increased when increasing the temperature of wastewater. The optimum temperature was 40°C. But in application if it is not possible to increase temperature at treatment facility, even reduction efficiency of said water qualities at room temperature (30°C) is favorable value to use.

Keywords: Synthetic dyes, Microbes, Decolorize, Degrade, Bioremediation

Synthesis of Graphene Oxide from Graphite for Water Treatment

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Carbon containing materials are typically used as an adsorbent for water treatment, specially to remove heavy metals, toxic anions, and dye stuffs. In this research, graphene oxide is synthesized from graphite using modified Hammers method for lead removal application. Synthesized grapheme oxide is identified by high resolution thermogravimetric (HR-TGA) studies where graphene oxide tends to decompose in the temperature range of 570-640 ^{o}C. Surface properties of graphene oxide including the specific surface area, total pore volume, pore width, single point pore volume, microporous volume is measured by using nitrogen adsorption desorption analyzer at -196 ^{o}C using liquid nitrogen and calculated those properties using KJS (Kruk Jaroniec, Sayari) method. Total pore volume, specific surface area, pore width, single point pore volume, microporous volume of graphene oxide, respectively, are ~ 0.24 $cm^3 g^{-1}$, 41 $m^2 g^{-1}$, 7.6 nm, 0.22 $cm^3 g^{-1}$, and 0.01 $cm^3 g^{-1}$. Synthetic lead solutions are used to study the adsorption and kinetic behavior of graphene oxide. Lead ion concentration are measured using atomic adsorption spectrophotometer. Kinetic sorption reveals that 2-3 hour is required to achieve the equilibrium condition. Graphene oxide adsorption process is well fitted with pseudo-second-order kinetic model than pseudo-second-order showing regression coefficient value (R^2) of 0.9991 and reached to the adsorption capacity of 100 mg g^{-1}.

Keywords: Graphene Oxide; Adsorption; Lead Removal

Compliance of Wastewater Standard by Textile Industries at Board of Investment - Biyagama Export Processing Zone (BOI - BEPZ)

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Untreated wastewater is responsible for variety of environmental and health problems. In BOI-BEPZ there are 11 textile and dying factories, and wastewater generation is approximately 7800 $m^3 day^{-1}$. These industries have their own wastewater treatment plants to treat wastewater chemically in-house until it meets zone's tolerance limits for industrial wastewater discharge into common wastewater plant. However, these in-house treatment plants have many drawbacks and also the effluent water quality does not meet the tolerance limits given by the Board of Investment. These violations impair the performance of the common wastewater treatment plant. The main objective of this research is to investigate the compliance of the wastewater with the limits for discharge to the common wastewater treatment system in the zone and to identify reasons in case of noncompliance. In-house treated wastewater was collected from selected textile industries in the zone. Physio-chemical parameters such as pH, Temperature, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solids were analysed. After analysing it was identified that ten out of eleven factories that were investigated, exceeded at least one of the above parameters. All treatment plants mainly use chemical treatment processes for wastewater treatment, and the amount of chemical needed to bring wastewater to compliance limit is high. Further, these chemical processes produce high load of sludge usually exceeding 50,000 kg $month^{-1}$, spending high amount of money on sludge disposal. Therefore, this study suggests alternative methods to treat the wastewater by which the amount of chemical usage is reduced so that the cost on the chemicals and the amount of sludge formed is reduced.

Keywords: Textile industrial wastewater treatment, Chemical treatment

Removal of Fluoride from Water using Zeolite

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The excess fluoride concentration in groundwater has become a major issue among many countries in the world. Also, in Sri Lanka several districts are affected with excess fluoride in groundwater. The main aim of this study was to introduce a cost effective and environmentally friendly fluoride removal method by using zeolite. A batch adsorption study was conducted at pH 7 and at room temperature by using test solutions containing 10 mg L^{-1} of initial fluoride concentration. The removal efficiency of adsorbent was studied by using different parameters like dose, contact time, stirring rate and initial fluoride concentration. The dose of adsorbent having the optimum fluoride removal efficiency was found to be 2.5 g. The optimum contact time, optimum stirring rate and the optimum initial fluoride concentration were found to be as 16 hours, 120 rpm and 8 mg L^{-1}, respectively. Both the Langmuir and Freundlich adsorption isotherms fitted well for the fluoride adsorption on zeolite with the regression coefficient R^2 of 0.96 and 0.97, respectively. Zeolite gave around 45% of fluoride removal efficiency and certain modifications to zeolite are needed to increase the efficiency.

Keywords: Zeolite, Adsorption, Removal efficiency, Langmuir, Freundlich

Contamination Status of Pathogenic Bacteria and Water Quality of Groundwater in *Angunukolapelessa*, Sri Lanka

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Waterborne infections are common and widespread when clean water and sanitation are poor. In Sri Lanka, 2588 *Salmonella* positive cases have been recorded from 2005 to 2013. Therefore, the present study was carried out to evaluate the chemical contamination status of 70 well water sources in *Angunukolapelessa* area where only 30 wells were subjected to microbial analysis to cover *Angunukolapelessa* divisional secretariat division during October 2018. Total coliform, faecal coliform, *Salmonella* spp. and *Shigella* spp. were screened along with some physico-chemical parameters of groundwater. Sampling, transportation and analysis were done following the standard protocoles. Statistical analysis was done and thematic maps were prepared using ArcGIS software. Results of the study revealed that entire area was contaminated with both total and faecal coliform bacteria and the values were not within the SLS and WHO drinking water quality standards. Twenty percent of collected samples were positive for *Salmonella* spp. and most of the locations are being used to extract water for drinking purposes. However, *Shigella* spp. was not recorded during the study period. Seventy-one percent of sampling locations were recorded as hard water (121 mg L^{-1}<) and around 16% of samples were not within the guideline values given by the SLS drinking water quality for Electrical Conductivity (EC). The minimum and maximum of pH and flouride concentration was recorded as 6.99 - 8.62 and 0.05 to 1.97 mg L^{-1} respectively where the highest flouride concentration was recorded from Daha amuna location. The tested other water quality parameters; $N\text{-}NO_2$, $N\text{-}NH_3$ and total phosphate (TP) concentrations were recorded within the Sri Lanka drinking water standards.

Keywords: Groundwater, *Angunukolapelessa*, Water quality, Salmonella spp, Shigella spp

Saltwater Intrusion into Freshwater Lagoons in Jaffna Peninsula

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Surface water and groundwater are scares and hence highly demanded resources in the Jaffna peninsula causing the communal water supply is an extreme challenge. In order to ease the burden, barrages were constructed closing fresh water lagoon envisaging the accumulation of rainwater during the monsoon periods. Though the initial expectation was the lagoons to act as freshwater ponds, due to malfunctioning of barrages the anticipation wilted. The barrages were reconstructed expecting the same purpose early this decade. However, the salinity has been unexpectedly high even since then irrespective to the climatic patters viz dry and wet seasons in the peninsula. This research focuses on understanding the behaviour of salinity variation in the Upparu lagoon and in the Thondamanaru lagoon which is under the spot light nowadays. Several investigations of the salinity variations across the Upparu barrage showed that there are subsurface linkages with high saline water from the Jaffna lagoon. In addition to that, the evaporation during dry season increases the salinity away from the barrage toward the mainland. The electrical conductivity (EC), salinity, sodium and chloride concentrations were measured in 58 groundwater wells around the lagoon as the lagoon water recharge the nearby groundwater table. The EC varies between 954 µS cm^{-1} to 13450 µS cm^{-1} in the wet season and it is between 673 µS cm^{-1} to 18570 µS cm^{-1} during the dry season. The salinity varies from 0.63 to 10.32 in the wet season, where as it is 0.92 to 12.3 in the Dry season. Chloride concentrations vary between 49.70 mg L^{-1} and 3012 mg L^{-1} in wet season and between 33.5 mg L^{-1} and 5538 mg L^{-1} in dry season. Sodium concentrations vary between 43.1 mg L^{-1} and 5324.3 mg L^{-1} in wet season and between 17 mg L^{-1} and 4124 mg L^{-1} in dry season. The groundwater quality far from the barrage is comparatively good to the areas closer to the barrage. This observation has been appearing with promising prospectus over last six years. Yet, it is not convinced whether this is due to the less effectiveness of the barrage or subsurface movement of brackish water from the Jaffna lagoon to the south Kopai area. Additionally, the dry period of this year was longer than usual. Thus, it is recommended to continue the research focusing more on south Kopai area.

Keywords: Freshwater pond, Upparu lagoon, Saltwater barrage, Salinity, Seawater intrusion

Investigation on the Manganese Phase Diagram when Manganese is Reacting with Calcium Hypochlorite

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Oxidation Reduction behavior of different substances highly contributes to the condition of water and phase diagram express the relationship between Eh and pH of a particular substance. When Manganese is in water, it can exist either as suspension matter or as dissolved matter and exact speciation can be determined by investigating the Manganese phase diagram. The objectives of this study were to investigate a suitable method to reduce excess Manganese from water by flocculation and filtration process and identify the different species of Manganese from phase diagram which can be removed from water as insoluble form. Excess concentration of Manganese was reduced by oxidizing to an insoluble form using Calcium hypochlorite and resulting insoluble form was removed by flocculation and filtration. Behavior of the Manganese species fluctuates with different pH and Eh values. The pH values of the samples were measured directly by pH meter and Eh values were determined by both calculated value from Nernst equation and measured value as oxidation reduction potential. After 30 minutes of time residual Chlorine values of all the trials were zero. Manganese rich water was synthetically prepared by adding MnSO4 in to raw water sample collected from Maguru Oya, Wariyapola. Manganese was removed as a brown color deposition which was confirmed as Mn3O4 (Hausmannite) by Manganese phase diagram. This deposition can be removed by using suitable filtration process and removal efficiencies were 33%, 22%, 11% and 0 with concentration of Calcium hypochlorite of 0.6 ppm, 0.7 ppm, 0.8 ppm and 0.9 ppm respectively. That need to be confirmed by further studies because raw water sample may have different cations and anions.

Keywords: Oxidation reduction potential, Phase diagram, Oxidation

Determination of a Suitable Treatment Methodology to Treat Rice Washed Water Released from Rice Mills

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In this experimental study, the wastewater eliminated from the rice washing in the rice mills is taken into account. This wastewater possess very high COD, BOD and turbidity and do not comply with the wastewater discharge limits imposed by the National Environmental Regulations No 01 of 2008 of Central Environmental Authority. Five methods were used to treat the rice washed wastewater and its efficacy have been analyzed mainly through the variation of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). By doing this research, it is intended to obtain water that is suitable to discharge into the environment. The five methods tested are, biological treatment method by using the Moving Bed Biofilm Reactor (MBBR), physical method by applying heat, chemical treatment by using 99% alum, treatment with hydrogen peroxide and ferrous sulfate and finally by treatment with activated carbon. In the MBBR treatment, COD and BOD removals were 53.15% and 29% respectively. On heating, the most efficient COD and BOD removal was obtained at 45ºC. Adding 99% alum did not show any efficacy towards the removal of COD and BOD. When 200ml of raw water was treated with 30% hydrogen peroxide 5 ml, and ferrous sulfate 0.6 g, and overnight stirred, COD and BOD removals were 85.7% and 88% respectively. When 200 ml of raw water was treated with 0.5 g of activated carbon, the COD and BOD removals were 87.5% and 90% respectively. From the results obtained, it can be concluded that using activated carbon is the most efficient among the treatment methods used for removal of COD BOD and turbidity and using hydrogen peroxide and ferrous sulfate too can be considered an efficient method as it too has a higher removal percentage of COD and BOD. MBBR treatment is a moderately efficient method. Applying heat and using alum are inefficient. From the data obtained from Fourier Transform Infrared Spectroscopy, the substances responsible for the rise of COD and BOD were recognized.

Keywords: Moving bed biofilm reactor, Biological oxygen demand, Chemical oxygen demand

Food Science & Technology

- Food Microbiology
- Food Chemistry
- New Product Development
- Dairy, Meat, Fish and Egg Technology
- Cereal, Grain, Fruit, Vegetable, Spice and related Product Processing Technology
- Beverage Technology
- Food Safety and Quality

Citrus Fiber® Enhances the Physicochemical and Sensory Attributes of Set-yoghurt

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Yoghurt is the most popular fermented milk product in the world. Stabilizers are used to enhance physicochemical and rheological properties of yoghurt. Aim of this study was to find out suitable "vegetable-based" stabilizers for set-yoghurt production. Preliminary studies were conducted to select the most suitable types and the level of stabilizer (% w/v). Set-yoghurts were developed by adding four selected stabilizers (gelatin, citrus fiber®, xanthan gum and carrageenan) at the rate of 0.3% (w/v). The pH, titratable acidity, viscosity and syneresis were analyzed weekly at 4 ºC ±1 during the 21-day storage period. The viscosity of yoghurt samples were measured using a Brookfield viscometer while syneresis was measured using suction filtration. Proximate and microbial analyses were carried out to determine suitability of products according to the CODEX and SLSI standard. Sensory evaluation was conducted to select the best yoghurt sample. Proximate composition results were not significantly different among all set-yoghurt samples ($P>0.05$). The pH, acidity, syneresis and viscosity values were not significantly different ($P>0.05$) between citrus fiber and gelatin added set-yoghurt samples. Citrus fiber® and gelatin added set-yoghurt samples obtained, significantly ($P<0.05$) lower pH values and higher acidity values. Carrageenan added set-yoghurt samples obtained, significantly ($P<0.05$) higher viscosity value while xanthan gum added set-yoghurt samples obtained the lowest value. Citrus fiber® and gelatin added set-yoghurt samples obtained, significantly ($P<0.05$) lowest syneresis value. Citrus fiber® added set-yoghurt samples recorded highest sensory scores for appearance, aroma and taste while gelatin added set-yoghurt samples recorded highest value for texture. These results indicate that citrus fiber added set-yoghurts have similar characteristic of gelatin added set-yoghurt. Therefore, citrus fiber® can be used to replace gelatin in set-yoghurt industry.

Keywords: Stabilizers, Set-yoghurt, Citrus fiber®, Gelatin, Syneresis, Viscosity

Development of Dairy Free Cereal Based Coconut Yoghurt Rich with Naturally Formed Vitamin B_{12}

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Yogurt is a popular fermented dairy product and the study was designed to access the possibilities to develop a dairy free cereal based coconut (DFCBC) yoghurt which broadens the diversity of yoghurts, while enhancing its health benefits. DFCBC yoghurt with naturally formed vitamin B_{12} was produced by incorporating four different ratios of coconut milk and rice milk (cooked rice fermented with coconut water for 12 hours) while replacing cow's milk. Yoghurt was produced with inoculating starter culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (0.025%) to achieve a pH of 4.5 while replacing gelatin with different combinations of agar-agar, carrageenan and pectin. Best combination of coconut milk: rice milk having product was further succeeded with different flavor components (vanilla, coconut honey and banana) to obtain the best quality product. Proximate analysis [moisture, ash, fat, protein, carbohydrates (AOAC methods), total solids (TS), vitamin B_{12} (HPLC method)] and shelf life determination were conducted for the final product. Sensory analysis was done using thirty semi-trained panelists and results were statistically (Kruskal-Wallis) analyzed. The product obtained with 1:1 ratio of coconut milk to rice milk including 1.25% agar-agar, 0.15% carrageenan, 0.1% pectin and addition of coconut honey as the natural sweetener was selected as the best combination for DFCBC yoghurt. Proximate analysis revealed the availability of 66.03 ± 0.05% moisture, 11.87 ± 0.04% fat, 1.34 ± 0.02% protein, 0.72 ± 0.01% ash, 0.36 ± 0.01% crude fiber, 19.68 ± 0.23% carbohydrate, 33.97 ± 0.12% of TS and 1.5µg Vitamin B_{12} per 100g of the yoghurt and observed for a shelf life of 30 days at 4^{o}C, proving absence of *Escherichia coli* and mold count, lower yeast count (<10 cfu g^{-1}), pH (4.50 ± 0.04), acidity (0.8 7± 0.05) accordance with the limits of SLSI. Development of DFCBC yoghurt could be used to satisfy consumer demands for the healthy functional foods with versatile health-benefits.

Keywords: Coconut yoghurt, Cereal based yoghurt, Rice milk, Dairy free yoghurt, Vitamin B12

Development of Natural Food Colourant from *Melastoma malabathricum* (Maha Bovitiya) Fruit

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Natural food colourants have become a global trend due to its excellent health benefits and less side effects rather than properties as colourants. Availability, taste and stability are some of the limitations associated with natural food colourants. Maha bovitiya (Melastoma malabathricum) is a commonly available plant with attractive coloured fruits which are sweet in taste with a pleasant smell and used for Ayurvedic medicine in Sri Lanka. There is a great potential to develop natural colourant from Maha bovitiya fruit due to its positive characteristics. However, detailed investigation on colourant properties of Maha bovitiya is limited. Thus, this study was performed to develop a natural food colourant using M. malabathricum fruit. Methanol (99.9%), distilled water and acetone were used as three different solvents to select the best solvent for the extraction. Pigment stability of selected extract (99.9% Methanol extract) was calculated by half life time using regression analysis and Arrhenius equation in different treatments as temperature (27□C, 40□C and 100□C), pH (4, 5 and 6) and light intensity (presense or absence). Consumer preference for pigment was determined by paired preference test using two tailed binominal test. Results indicated that methanol was the best solvent with 12.45 mg ml-l extract. Highest half life time was recorded as 78.13 hours in the sample of 27□C at pH 5 in the absence of light. M. malabathricum fruit colourant has a high consumer preference compared to artificial colourant (E131) with 5% significance level. Results clearly revealed that M. malabathricum fruit extract has a good potential as a natural food colourant in food industry due to acceptable stability and high consumer preference.

Keywords: Maha Bovitiya, *Melastoma malabathricum*, Natural food colourant, Pigment extraction, Pigment stability

Effects of Hik Tree (*Lannea coromandelica*) Wax on Internal and Sensory Attributes of Chicken Eggs Stored Under Room Temperature

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To increase the shelf life and to preserve the nutrient content under room temperature mineral oil used as an external coating material for eggs. But it is very expensive and dry slowly than other coating materials. Hik tree (*Lannea coromandelica*) is a tropical tree grown in dry zone in Sri Lanka and its wax has film forming properties. However, information on Hik tree wax coating on egg quality attributes does not exist. Therefore, this study was done to check the effect of Hik tree wax as an external coating material on shelf life, internal quality and sensory attributes of chicken eggs during storage under room temperature. Total of 306 white, medium sized, clean eggs were purchased from a commercial layer farm in Mahiyanganaya. Eggs were individually weighed and arranged under completely randomized design to 03 different coating treatments as Hik wax (HW), mineral oil (MO), and non-coated (NC) and stored under room temperature (27±2°C) for 6 weeks. Weight losses, Haugh unit (HU), albumen and yolk pH, air sack volume and microbial analysis for Salmonella sp. were determined weekly with 03 replicates. Sensory attributes of eggs were measured using 30 untrained panelists. FTIR analysis was conducted to analyze the structural changes in egg albumen. Results revealed that weight losses were minimum in MO coated eggs than in other treatments ($p<0.05$). HU decreased from 88.00 to 57.34 significantly in NC eggs compared with HW or MO ($p<0.05$). Albumen and yolk pH values increased during the storage in all treatments ($p>0.05$) and air sack volume increased from 0.41 cm to 0.71 cm during storage ($p>0.05$). However, grade of coated eggs reduced from AA to B within 04 weeks. All coated eggs were negative for *Salmonella* test during the study period. Color of the egg yolk did not change due to coating material ($p>0.05$). FTIR data confirmed that no chemical changes occurred due to wax coating. In conclusion, the present study confirmed that Hik tree wax can be used as an external coating material replacing MO.

Keywords: Hik tree wax, Mineral oil, Internal quality, *Salmonella*, Sensory properties

Assessment of Oxidative Stability and Fatty Acid Composition of Gamma Irradiated Edible Oils

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The safety and shelf-life of food products can be enhanced by modern food processing techniques such as irradiation. This study was carried out to investigate effects of gamma irradiation on fatty acid composition and oxidative stability of nine edible oils including Coconut oil, Corn oil, Sunflower oil, Soybean oil, Vegetable oil, Cod liver oil, Commercial fish oil, Tuna oil and Thilapia oil. The irradiation was applied at 15, 30, 45, 60 and 75 kGy levels using Cobalt-60 radiation source at Sri Lanka Gamma Center. The oxidative rancidity of oil samples was tested by Peroxide value (PV) and Thiobarbituric acid value (TBA) tests. The fatty acid profiles were determined by capillary column gas chromatography with flame ionization detector. The lowest and the highest PV were shown in Coconut oil (0 meq/kg) and Vegetable oil (10.54 meq/kg). All the samples showed their highest PV at 15 kGy dose whiles the lowest PV at 75 kGy dose. The TBA values of fish oils were significantly ($p < 0.05$) higher than plant and vegetable oils. The highest TBA value (270.37 nmol/g) was shown in Thilapia oil irradiated at 15 kGy. The lowest TBA value (2.41 nmol/g) was reported in control sample of Coconut oil. The fatty acid profiles of treated oils showed substantial stability during irradiation. Oleic acid (C18:1 ω-9) was the most abundant fatty acid in vegetable oils (43.78%) followed by in Tuna oil (24.84%) and Thilapia oil (30.79%). Linoleic acid (C18:2 ω-6) was the highest abundant fatty acid in Corn oil (50.00%), Sunflower oil (48.75%) and Soybean oil (52.79%). Lauric acid (C12:0) was the highest abundant fatty acid in Coconut oil (43.55%). Higher amount of Docosahexaenoic acid (C22:6 ω-3) was recorded in Tuna oil (18.89%), fish oil (10.06%) and Cod liver oil (10.22%). However, gamma irradiation at 15-75 kGy doses did not show any significant ($p<0.05$) effect on the fatty acid composition of any edible oil where they showed a good stability during irradiation processing.

Keywords: Gamma irradiation, Edible oils, Fatty acid profile, Peroxide value, Thiobarbituric assay

Aroma Volatiles of Ambul Banana (*Musa acuminata*, AAB) as Affected by Artificial Ripening Agents

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The characteristic aroma is a crucial quality parameter in banana fruit. This study is to evaluate aroma profile of artificially ripened banana compared to naturally ripened banana. Freshly harvested green mature banana (*Musa acuminata*, AAB) in same maturity stage were treated with 1000 ppm ethephon, 1000 ppm acetylene, natural ethylene emits from fruits and wood smoke, stored at 25^{o}C and 80% RH until fruits get fully ripened. Aroma profile was analyzed in 48 hour intervals using Headspace- Solid Phase Micro-extraction (HS-SPME) as sampling method and gas chromatography with mass spectrophotometer for the analysis of compounds. Aroma compounds were adsorbed using SPME fiber (Carboxen-polydimethylsiloxane-divinlybenzene, 50 mm) by exposing the fiber to headspace of the sample at 60^{o}C for 10 min. The number of aroma compounds detected was 28 in naturally ripened fruits at fully yellow stage (stage 6) including esters, carbonyl compounds, alcohols and volatile phenols, while it was 21, 19, 17 and 17 in the samples treated with natural ethylene emits from fruits, smoke, acetylene and ethephon, respectively. Ethyl acetate, isobutyl hexanoate, butyl butanoate, [(E)-Hex-4-enyl] butanoate, Isopentyl hexanoate, [(E)-Hex-4-enyl] hexanoate,1-Ethylcyclohexene, Z-4-Dodecenol were detected only in naturally ripened samples at stage 6. Butanoic acid, ethyl ester; 3-methylbutyl acetate; butanoic acid, 3-methylbutyl ester and butanoic acid, propyl ester was found as most abundant esters at stage 6 in naturally ripened samples. However, butanoic acid and propyl ester were absent in ethephon and carbide treated samples. 3-methylbutyl acetate which is the major compound responsible for banana like odour was detected in all samples at stage 6. Number of esters was highest in naturally ripened samples (19) while it was lowest in acetylene treated fruits (12). Poor aroma profile of artificially ripened fruits may lead to low sensory properties.

Keywords: Solid phase micro-extraction, Induced ripening agents, Odour active compounds, Banana aroma

Development of Low-fat Chicken Meat Paste with Dried Bitter Gourd (*Momordica charantia*) Powder

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Chicken meat paste is one of the value added products which is popular among consumers mainly due to convenience. However, considerable number of consumers in Sri Lanka believes that meat products cause harmful effects on human health mainly due to the fat content. Hence, the aim of this study was to develop a value added low-fat meat paste from cheap cuts of chicken meat by incorporating bitter gourd. Chicken meat from cheap cuts was boiled to an internal temperature of 70 ^{o}C and minced. Then, it was mixed with other ingredients to make the meat paste according to a recipe developed through preliminary trials. Treatments were prepared by incorporating dried bitter gourd powder (DBGP) prepared using oven drying method (50 ^{o}C/8 hrs) at 1.0, 1.5, 2.0, 2.5 and 3.0% (w/w). Meat paste with no DBGP was used as the control. All treatments were then pasteurized at 85^{o}C for 15 minutes. A sensory evaluation was conducted to select the two best concentration of DBGP to be added. Selected treatments and control were vacuum packed, and tested for the nutrient composition, physicochemical parameters, TBARS value, microbial quality, and antioxidant capacity over a one-month storage period under refrigerated condition (4^{o}C).Meat paste with 1.5% and 2% (w/w) DBGP had the best sensory qualities ($p<0.05$). Meat paste with 2% (w/w) DBGP contained the highest ash content (4.82%) and water holding capacity (81.62%), and the lowest fat content (2.16%), pH value (6.45%) and colour parameters ($p<0.05$). In addition, meat paste with 2% (w/w) DBGP showed the highest antioxidant capacity (41.82%) among the treatments ($p<0.05$). Based on TBARS value and microbial data, DBGP incorporated meat paste can be kept without deterioration for 30 days under 4 ^{o}C. Therefore, DBGP at 1.5% and 2% (w/w) can be recommended to produce low fat meat paste with better sensory properties.

Keywords: Bitter gourd, Physicochemical, Meat paste, Sensory, Antioxidant capacity

Development of Pond Apple (*Annona glabra*) Ready-To-Serve Drink and Evaluation of Its Quality Parameters to Popularize the Utilization of Underutilized Fruits

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Pond apple (*Annona glabra*) is a tropical fruit species in the family Annonaceae and called "*Wel Atha*" in Sinhalese. The fruit is edible and the flesh is attractive yellow in colour, highly fragrant, unique and appealing in aroma, but it has not come to general popular consumption unlike Soursop and other fruit in same family due to the myth in community as it is a toxic fruit. Therefore, this is a one of very much underutilized fruit in Sri Lanka. However, all the plant parts are commonly used in Ayurveda medicine due to their superior febrifuge, antidote, emetic, fungi static, antibiotic and anticarcinogenic activities. Therefore, the proposed study was aimed to investigate the utilization of pond apple fruits to develop Ready-To-Serve (RTS) drink and to evaluate its sensory, physicochemical and microbiological properties in order to emphasize and popularize the edibility of this underutilized fruit. The pond apple RTS drink was prepared using fresh ripen pond apple fruit pulp, water, refined sugar (sweetener), citric acid (acidulant), pectin (stabilizer) and sodium metabisulfite (preservative) and bottled using glass bottles and caps. The best consumer preferred formula was selected using an untrained panel consisted of 30 panelists. A drink with 10% fruit pulp, 15% sugar, 74.6% water, 0.2% citric acid, 0.1% pectin and 0.1% sodium metabisulfite at 15 ^{o}Brix was found as best formula by sensory evaluation for RTS drink production. The pH, titratable acidity and ^{o}Brix or total soluble solids (% TSS) were 3.50±0.01, 0.37±0.01% and 15.2±0.2%, respectively with achieving the final product specifications of RTS fruit drink. The total sugar content was 18.04±0.5% according to phenol-sulfuric acid method and ascorbic acid (Vitamin C) content was 10±0.36 mg 100 ml^{-1} according to DCPIP method. Eventually, it can be concluded that the pond apple RTS drink can be effectively used to popularize the consumption of pond apple fruit in the community.

Keywords: *Annona glabra*, Pond apple, Ready to serve, RTS drink, Underutilized fruits

Investigation of Functional Properties and Phytochemical Screening of Selected Fruit Peel Powders

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Main solid waste in fruit processing industry is fruit peels. Manufacturing industries have to spend excess money, labor, and space to dispose them. Therefore, reducing, recycling or reusing such peels is a timely requirement. The aim of this study was to ascertain the total phenolic content (TPC; Folin–Ciocalteu method), and antibacterial activities (agar well diffusion method) and to screen the phytogenic chemical compounds (chemical methods to evaluate the presence of tannin, steroids and cardiac glycosides) of selected fruit peel powders to determine their suitability for use as natural food additives. In the present study, four varieties of fruit peels; pineapple, orange, yellow passion fruit and avocado were collected from fruit waste of Sri Lankan food industries. Water extracts and methanol extracts of dried samples (at 50^{o}C until constant weight) were tested for TPC and antibacterial activity for six different pathogenic bacteria; *Staphylococcus aureus, Shigella dysenteriae, Escherichia coli, Listeria monocytogenes, Streptococcus pneumonia* and *Salmonella typhi*. According to the results, highest TPC was observed in the methanol extract of orange peel (15.83±0.40 GAE mg/g) while water extract of avocado peel (1.72±0.01 GAE mg/g) showed the least TPC. No antibacterial activity was observed for water extract except pineapple peel for *Salmonella typhi*. Antibacterial activity of methanol extract was higher than that of water extract. All samples contained cardiac glycosides while steroids are present only in orange peel. Pineapple peel and avocado peel were free of tannins. All the functional properties were less than the previous studies for raw peels. That may be due to prolonging drying time of fruit peel powders. Therefore, optimization of processing conditions for powder preparation is needed.

Keywords: Antibacterial, Antioxidant, Fruit peel powders, Phytochemicals

Optimization of the Methanolic Extraction Procedure for Chemical Preservatives in Ready to Serve Jelly Drinks by Response Surface Methodology

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Ready to serve (RTS) jelly drinks which are widely consumed by school children in Sri Lanka contain Benzoic acid and Sorbic acid as chemical preservatives. This research was aimed to optimize the methanolic extraction procedure for rapid analysis of these two preservatives in RTS jelly drinks using High Performance Liquid Chromatography (HPLC). Response Surface Methodology (RSM) adopting Box Behnken design was used to determine the effects of 03 independent variables namely, ammonium acetate/acetic acid: methanol ratio (v/v), ultrasonic extraction time and ultrasonication temperature on recovery percentages of benzoic and sorbic acids. Independent variables were used at 03 levels with a center point. A negative matrix having similar chemical and physical properties to jelly drinks, spiked with 100 ppm of each benzoic and sorbic acids was used. These matrices were extracted using the 15 experimental conditions suggested by the Box Behnken design. Regression analysis was carried out for fitting the response surface model for all the responses and all linear and quadratic terms of the independent variables. The predicted optimum extraction conditions for ammonium acetate/acetic acid: methanol ratio, ultrasonic extraction time and temperature were 60:40 (v/v), 15 min. and 30 ^{o}C, respectively, at desirability level of 0.95. The benzoic acid and sorbic acid recovery percentages at optimum extraction conditions were 98.36±0.90% and 97.82±0.90% respectively. It showed no significant difference ($p>0.05$) to the predicted values of 97.86 and 96.43 for benzoic and sorbic recovery percentages, respectively.

Keywords: Benzoic acid, Jelly drinks, Sorbic acid, Response surface methodology

Utilization of Jackfruit Seed Flour (*Artocarpus heterophyllus* L.) as a Thickening Agent in Tomato Sauce Production

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Even though Jackfruit seeds are a good source of starch, they are still underutilized. This study investigated the potential of using of Jackfruit Seed Flour (JSF) as a thickening agent in tomato sauce production. Lye peeled mature jackfruit seeds were used to obtain flour. Proximate analysis and functional behavior of the JSF were compared with corn flour. Tomato sauce samples were prepared according to the Sri Lankan Standard specification for tomato sauce (SLS 260:1989). Three batches of tomato sauce were prepared by adding JSF, corn flour and without any thickening agent separately. Thickening agents were added at 3.75g/100g of tomato pulp. Sensory evaluation and microbial analysis were conducted to determine the acceptability of the sauce samples. Sauce samples were analyzed for physicochemical properties during 8 weeks of storage at ambient temperature. JSF contained 69.96±0.31% carbohydrate, 13.40±0.09% crude protein, 8.53±0.19% moisture, 2.93±0.15% crude fiber, 2.77±0.05% fat and 2.39±0.37% total ash. JSF had 0.80 g cm^{-3} bulk density, 2.5 ml g^{-1} oil absorption capacity, 1.4 ml g^{-1} water absorption capacity, 3.5 ml g^{-1} emulsifying capacity and 5% gelation capacity. Swelling power was increased with the temperature. JSF incorporated tomato sauce received the highest scores in the sensory assessment. Microbial counts were less than standard maximum limits. Total soluble solids, titratable acidity were not significantly changed ($p > 0.05$) while pH, water activity significantly increased ($p < 0.05$) during storage period in JSF added tomato sauce. JSF showed the role of a thickening agent in tomato sauce with lowest serum separation and highest viscosity. This study concludes that JSF can be successfully used as a thickening agent in the tomato sauce industry.

Keywords: Jackfruit seed flour, Thickening agent, Tomato sauce

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Healthy Plant Oils as Fat Replacers in Low Fat Chicken Sausages

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In commercial sausage production, animal fat is directly added as a fat source and it may cause ill-health effects. The present study was focused to develop healthy chicken sausages by replacing animal fat (chicken skin) with sunflower oil, soybean oil, coconut oil and olive oil and to evaluate their nutritional and sensory properties. Sausages were prepared separately incorporating chicken skin (control) and above mentioned oils according to the commercial guidelines. A sensory evaluation was conducted using 30 untrained panelists with 7-point hedonic scale. Based on sensory analysis results, the three best treatments were vacuum packed and compared weekly with the control for pH, colour, water holding capacity (WHC), cooking loss, proximate composition TBARS value and microbial quality for one month under frozen (-18ºC) condition. According to results, coconut oil, sunflower oil and soybean oil incorporated sausages showed better sensory properties than control and olive oil incorporated sausages ($p<0.05$). In addition, plant oils added sausages had lower fat content and higher ash content compared to control samples ($p<0.05$). Soybean oil added sausages had the lowest fat (4.69±0.27%) and the highest ash (2.31±0.04%) content. However, the protein and moisture content were comparable among the treatments ($p>0.05$). At the initial stage of storage, sunflower and soybean oil added sausages showed lower pH values ($p<0.05$). The lowest cooking loss values were shown in control and sunflower oil added samples ($p<0.05$). WHC values were comparable among treatments. In all treatments, pH and WHC values were decreased while cooking loss values were increased with storage. TBARS and total plate count values were increased with the time, but within the permitted levels. *Salmonella* and *Escherichia coli* were not present in all samples. Therefore, healthy plant oils can be used to replace chicken skin in manufacturing of low fat sausages.

Keywords: Chicken skin, Sunflower oil, Soybean oil, Coconut oil, TBARS

Determination of Nitrate and Nitrite in Pepper by High Performance Liquid Chromatography/Ultra Violet Method

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Determination of nitrate and nitrite in food stuffs emerged as a promising factor to be considered in human health after discovering the increased risk of carcinogenicity and blue baby syndrome. Therefore, it is considered as a necessary factor to be determined in edible vegetables, meat products and fruits which are considered as the major dietary sources of nitrate and nitrite. Among them, *Piper nigrum*, also known as pepper, cultivated for its fruits, usually dried and used as a spicing and seasoning agent which is relatively lies in the low category under the classification of edible vegetables according to the nitrite and nitrate content. Hence, this study is focused on determining nitrate and nitrite in homemade and commercially available pepper samples by High performance liquid chromatography equipped with diode array detector. The commercially available pepper samples were collected from supermarkets including three different brands and the homemade samples were selected from randomly selected pepper cultivated villagers around the Mulleriyawa area. Nitrate and nitrite in 12 different test samples of black pepper from fully matured unripe berries which are commercially available and homemade were extracted using a modified method from existing Nordic Committee of Food Analysis (NMKL). Nitrate and nitrite in test samples were simultaneously determined using High Performance Liquid Chromatography / Ultra Violet (HPLC/UV) method which includes a reversed phase zorbax eclipse plus C18 column, passed through an optimized mobile phase of 25% acetonitrile and phosphate buffer pH=3.5 in a isocratic elution, under the detection at 222 nm wavelength with a flow rate of 0.7 ml min^{-1}. The statistically analyzed results emphasize that the average nitrate and nitrite content in analyzed homemade samples were 781.3 mg kg^{-1} and 309.8 mg kg^{-1}, respectively as well as in commercially available samples it was 1837.8 mg kg^{-1} and 165.4 mg kg^{-1}, respectively. The nitrate and nitrite content in majority of the analyzed pepper samples were higher than the level indicated under the classification in the publication of Council of Europe on nitrate and nitrite content in food stuffs (nitrate >250 mg kg^{-1}, nitrite <1 mg kg^{-1}) . The analyzed level of nitrate and nitrite in commercially available pepper samples were greater than in homemade pepper samples.

Keywords: Carcinogenicity, Nitrite, Chromatography, Nitrate, Isocratic

Impact of Gamma Irradiation on Control of Microorganisms in Export Oriented Moringa (*Moringa oleifera)* Powder and Flakes

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Moringa (*Moringa oliefera)* has a growing demand in export market mainly due to its health benefits. The study was carried out to evaluate the effect of different gamma irradiation doses to physical parameters and microbial quality of export oriented Moringa powder and flakes in Sri Lanka. Homogenized Moringa samples were collected from a particular exporter. Samples were irradiated at doses of 0 kGy, 2 kGy, 4 kGy, 6 kGy, 8 kGy and 10 kGy by industrial Co-60 gamma irradiator at dose rate 5.3 Gy min^{-1}. Under physical parameters, water activity, moisture content, color and infusion color (ΔE value based on L*, a*, b* in Hunter color scale) were measured for each of the treatment. Under microbial safety, total plate count, yeast and mold count and coliform counts were done. All treatments were replicated in three times. Average moisture content of irradiated Moringa powder and flakes were 6.32±0.04% and 6.09±0.03% respectively. Average water activity of irradiated Moringa powder was 0.41±0.00 and irradiated Moringa flakes was 0.44±0.03. Mean values of color and infusion color of irradiated Moringa powder and flakes were not significantly different ($P<0.05$) with the control sample. The average total plate count in control sample of powder was $1.29\times10^{7}\pm2.47\times10^{5}$ CFU g^{-1} and flake was $4.5\times10^{5}\pm3.71\times10^{5}$ CFU g^{-1}, both irradiated Moringa samples showed significant reduction in dose dependent manner. No Yeast and Mold counts were observed in all the treated samples. *Escherichia coli* were identified in 0 kGy and 2 kGy samples only. It is concluded that the 6 KGy was better for Moringa flake and 8 kGy was better for Moringa powder for microbial safety, while preserving the physical quality.

Keywords: Moringa, Gamma irradiation, Dose, Microbial safety, Quality changes

Incidence of Pale, Soft, and Exudative (PSE) Chicken Meat at a Commercial Plant and Its' Effect on Marinated Chicken Breast

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Pale, soft, and exudative (PSE) condition is a growing problem in poultry industry. The studies in prevalence of PSE condition in Sri Lanka are minimal. Marination of meat helps in the improvement of meat quality traits. The objective of this study is to determine the incidence of PSE condition in a commercial plant, and to find out its' consequences on marinated chicken breast. A total of 195 randomly selected breast fillets were evaluated for color and the prevalence of PSE condition was recorded. A lightness (L*) value of 58.0 was used as the cutoff value for PSE meat characterization based on previous research. A total of 20 fillets, 10 PSE and 10 normal samples were selected and analyzed for color, pH and water holding capacity (WHC). The fillets were then processed into marinated and baked products. Processed samples from PSE and normal meat were compared for marinade uptake, marinade loss, cooking loss, color, pH, WHC, texture, and sensory properties. The incidence of PSE in the present study is 93.3%. PSE fillets had higher lightness (L*) and lower redness (a*) values compared to normal fillets ($p<0.05$). However, pH and WHC values of raw meat were comparable between the two groups ($p>0.05$). PSE fillets had higher L* values than the normal fillets even after marinating and baking ($p<0.05$). In addition, WHC of marinated and baked fillets were higher in normal fillets ($p<0.05$). However, pH and cooking loss values are similar between PSE and normal fillets after marinating and baking ($p>0.05$). Sensory properties of baked fillets were comparable between PSE and normal samples. In conclusion, approximately 4% lower WHC in marinated and baked breast fillets were identified as the consequence of PSE condition.

Keywords: Color, Water holding capacity, Marination, Broiler meat, PSE

Industrial Potential of Mango (*Mangifera indica L.)* Peel and Seed

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The present study was undertaken to investigate the optimum conditions for extracting carotenoids from mango peel to identify the most abundant pigment in the extract and to evaluate the proximate composition, total phenolic, flavonoid and antioxidant capacities of mango peel and seed. Box-Benkhen design of Response Surface Methodology (RSM) was employed to determine the optimum extraction conditions. Fifteen experimental runs with different combinations of ethanol level (50.0, 72.5 and 95.0%), temperature (25, 50 and 75^{o}C) and time (30, 60 and 90 min) were performed on mango peel for extracting carotenoids. Extracting with 50.0% ethanol at 25^{o}C for 90 min resulted in the highest yield (82%) of carotenoids. To identify the major carotenoid in the extract, the extracted carotenoids were subjected to Thin Layer Chromatography after separating from 10% NaCl followed by distilled water. The most abundant carotenoid in mango peel was found to be β-cryptoxanthin as indicated by an R_f value of 0.53. Proximate analyses of mango peel and seed revealed presence of 3.10 and 5.94% of crude protein, 4.43 and 8.10% of crude fat and 18.78 and 13.04% of crude fibre, respectively. Total phenolic content of 8.64 and 9.47 GAE g^{-1}, flavonoid content of 12.64 and 21.82 RUE g^{-1} and total antioxidant content of 25.54 and 20.27 AAE g^{-1} were evident in mango peel and seed, respectively. The antioxidant capacity of 1.66 and 0.53 ppm were reported in mango peel and seed from the DPPH free radical scavenging assay. These findings revealed the potential of mango peel and seed, which are discarded from fruit processing industries, for possible use in nutraceutical and functional foods.

Keywords: Antioxidant activity, Box-Behnken design, Carotenoids, Mango peel, Mango seed

Effect of Osmotic Dehydration on Quality of Green Chili Powder

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Green chili (*Capsicum annuum* L.) is commercially grown as a spice crop. Rapid changes in post-harvest quality and the price fluctuation are the main problems facing green chili industry in Sri Lanka. In this study, concentration of chlorophyll a, b and total chlorophyll, moisture content, water solubility, rehydration time, ascorbic acid content (2, 6-dichlorophenol-indophenol method), total phenolic content (Folin-Ciocalteau method), total antioxidant activity (DPPH method), total plate count and yeast and mold count of osmotic (5% NaCl) and non-osmotic dehydrated green chili powder samples (Variety MI 2) were investigated. To investigate the consumer preference, a sensory evaluation was done. Low moisture (4.00%), higher total antioxidants concentration (4.26×10^{-4} kg L^{-1}), ascorbic acid concentration (9.04×10^{-4} kg L^{-1}), rehydration time (8.25 s) and low total plate count were observed in osmotic dehydrated green chili powder when compared with the non-osmotic samples. Best green color with high chlorophyll a (2.39×10^{-6} kg L^{-1}), b (4.50×10^{-6} kg L^{-1}) and total chlorophyll (6.88×10^{-6} kg L^{-1}), high water solubility index (3.94%), total phenolic content (1.52×10^{-4} kg kg^{-1}) and low yeast and mold count were exhibited in non-osmotic dehydrated green chili powder samples. There was significant difference between osmotic and non-osmotic samples of all above parameters except the ascorbic acid content. In the sensory evaluation, non-osmotic samples obtained the higher ranks for color, taste, aroma, texture and mouth feel. The osmotic dehydrated product obtained the highest score for overall acceptability. However, the osmotic dehydration technique is the most favorable for commercial level green chili powder production due to their good physicochemical and nutritional characteristics.

Keywords: Green chili powder, Osmotic dehydration

Development of Value Added Products from Tilapia: A Preliminary and Innovative Approach to Improve Tilapia Fishery Sector in Sri Lanka

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Tilapia is one of the popular freshwater food fish in aquaculture industry over the world including Sri Lanka. The present study focused on development of low cost, value added, nutritional fish products using Nile Tilapia: *Oreochromis niloticus*. Raw tilapia fish were purchased from Sorabora reservoir, Badulla. Fish wafer was processed using three different ratios of tapioca and corn flour (Treatment 1-1:1; Treatment 2-2:1; Treatment 3-5:1). Minced fish was used to prepare the fish noodles using four treatments with different flour and oil combinations (Treatment1: wheat flour 43%+coconut oil 1.5%; Treatment2: wheat flour 43%+ vegetable oil 1.5%; Treatment3: red rice flour 43%+ coconut oil 1.5%; Treatment4: red rice flour 43%+vegetable oil 1.5%). Final products in polythene packaging were analyzed for organoleptic parameters, proximate composition, keeping quality tests and color during 28 days of storage period at room temperature. Fish wafer with 1:1 of tapioca: corn flour and fish noodles with 43% of wheat flour+1.5% of vegetable oil were recorded the highest overall acceptability from consumers ($P<0.05$).Average protein levels of fish wafer and noodles were 10% and 18%, respectively. Tapioca: corn flour ratio had a significant effect on lipid content of wafer products ($P<0.05$), while lipid levels of all noodles products were not significantly different between the treatments ($p>0.05$). There was no significant difference in color a* (redness), b* (yellowness), L* (lightness) values, pH, TBARS, moisture and ash contents among treatments of wafer (pH:7.48-6.60, TBARS:0.1-1.3 mg MDA kg^{-1}, moisture:12.52-14.38%, ash:3.20-5.26%) and noodle products (pH:7.43-6.46, TBARS: 0.2-1.5 mg MDA kg^{-1}, moisture:10.16-11.83%, ash:1.63-2.15%) implying suitability for consumption during storage period ($p>0.05$). The present study showed the possibility of processing value added fish wafer and noodles using low cost Tilapia as an alternative for conventional and expensive seafood sources.

Keywords: Production technology, Consumer acceptance, Nutritional value, Value added products, Nile Tilapia

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Probiotic Viability of Cow Milk Kefir during Storage

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Kefir is a popular fermented beverage produced by the action of bacteria and yeast. It is a natural probiotic product which has gained increasing interest among the health conscious consumers. Aim of this study was to develop cow milk kefir and analyze the probiotic viability during storage. Standardized cow milk was preheated at 95°C for 10 min and mixed with 5% of skim milk powder(w/w), 3.25% of gelatin(w/w) and different levels (0.5%, 1%, 1.5% and 2%) of sugar separately. Each batch of milk was heat treated at 105°C for 1 min, cooled to 40°C and inoculated with probiotic culture (*Bifidobacterium lactis*), yoghurt culture (*Streptococcus thermophilus and Lactobacillus bulgaricus*) and baker's yeast (*Saccharomyces cerevisiae*) at level of 1%. Milk mixes were incubated at 32°C for 6 h until pH reached 4.6. Based on preliminary studies, potassium sorbate at 0.03 % (w/w) was added just after incubation to restrict further alcohol development. *Bifidobacterium* and yeast counts in each product were analyzed using *Bifidobacterium* selective agar and yeast extract dextrose chloramphenicol agar at 1, 7 and14-day cold storage at 4°C. pH, titratable acidity, total solid and brix values were evaluated at 1, 7 and 14-day cold storage at 4°C.The kefir sample with 2% sugar was selected as the most consumer preferred sample ($P<0.05$) during sensory evaluation. *Bifidobacterium* count of the kefir incorporated with 2% sugar was significantly higher ($P<0.05$) compared to other samples after 14 days. *Bifidobacterium* count did not significantly decrease during 14 days of shelf life. Proximate analysis showed that kefir incorporated with 2% sugar contained 2.32% of protein and 1% fat. Results reveled that kefir can be kept in plastic bottles in refrigerated condition without deterioration for 14 days. The study further showed that kefir can be successfully developed as a probiotic product.

Keywords: *Bifidobacterium lactis*, Yeast, *Saccharomyces cerevisiae*, Titratable acidity, Gelatin

Formulation of Nutritionally Superior Energy Drink Using Locally Available Fruits and Vegetables

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Energy drinks provide electrolytes, readily available carbohydrates and B vitamins to enhance energy metabolism. Subsequently, energy beverages are supplemented with stimulants such as caffeine and other additives. Though energy drinks are very important to athletes, students and elderly people, long-term exposure to various components of energy beverages may cause adverse health effects. The present study aimed to develop a nutritionally rich natural energy drink using locally available fruits and vegetables. Products were prepared using different combinations of beet root, dragon fruit, watermelon, pomegranate and orange juices and king coconut water. These products were subjected to several sensory evaluations employing 9-points hedonic scaling by 40 untrained panelists. Data were analyzed by performing Friedman test ($P<0.05$) and best formula was selected. Initial mixture of juice was prepared using the selected formula and it was clarified by centrifuging with clarifying agents. Using this clarified juice, three sets of drinks were prepared by adding sodium benzoate and sodium metabisulfite separately as preservatives and without adding preservatives. Storage stability was evaluated by analyzing the physicochemical and microbiological properties of these samples during the storage under refrigerated condition (4^{o}C) and at room temperature (25^{o}C). Data were subjected to analysis of variance and mean separation ($P<0.05$). The selected best formula contained beet root (40%), watermelon (20%), pomegranate (30%) and orange (5%) juices and king coconut water (5%) by volume. It contained 54.74 kcal.g^{-1} energy and 12.37 g of carbohydrate per 100 mL. Shelf stable energy drink with good sensory properties can be formulated using beet root, watermelon, pomegranate, orange juices and king coconut water in proportions (percent by volume) of 40, 20, 30, 5, and 5 respectively and with 50 ppm of sodium benzoate as a preservative.

Keywords: Energy drink, Nutrition, Formulation, Fruits, Vegetables

Development of an Edible Coating Using Crude Sodium Alginate from *Sargassum ilicifolium* Incorporated with Ascorbic Acid for Minimally Processed *Artocarpus Heterophyllus* Lam

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Jackfruit *(Artocarpus heterophyllus)* lam is a highly available and demanded tropical food because its' sensory attributes are similar to meat. Many processes involved in minimally processing of Jackfruit lam. However, the challenge is the browning. Therefore, processors are in need of healthy, cost effective ways to minimize the browning. Hence, this study was conducted to minimize the browning in Jackfruit lam using an edible coating from seaweed hydrocolloid. Seaweed hydrocolloid was extracted from highly abundant, locally available, underutilized brown algae species, *Sargassum ilicifolium* by using sequential biorefinery extraction process. The extracted yield of crude alginate was 31.4% of alga (w/w). Sliced lam was coated using dipping method. Extracted crude alginate, commercial food grade alginate, gelatin with and without ascorbic acid were coated at the room temperature. Citric acid, ascorbic acid treated and uncoated samples were served as the control. Coated samples were stored separately at room temperature (27^oC) and refrigeration conditions (4^oC) for evaluate the physiochemical (Browning index, Radical Scavenging Activity, Thiobarbituric Acid Reactive Substances, Color and Texture) microbiological and sensory properties. Sensory analysis was conducted by serving boiled lam without adding any ingredients for 30 untrained panelists with 9-point hedonic scale. The UV spectrophotometric readings were indicated that the coating significantly reduce the browning compared to uncoated lam ($p<0.05$). Besides that, crude alginate with ascorbic acid were recorded as highest radical scavenging activity in 2,2-diphenyl-1-picrylhydrazyl assay, overall sensory quality, lowest microbial count in total plate count and extend the shelf life for 3 days at room temperature and 2 days under refrigerated conditions. Hence, ascorbic acid enhances the effectiveness of the coating. Then, Jackfruit lam coated with crude sodium alginate with ascorbic acid reduced the browning.

Keywords: Brown algae, Browning, Hydrocolloid, Bio-refinery extraction, Dipping method

Effect of Inulin as a Fat Replacer on Quality Traits of Chicken Sausages

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Inulin is a non-digestible carbohydrate which can act as a fat replacer in various foods. Garlic bulbs are known as a rich source of inulin. This study was conducted to review the effect of replacing vegetable oil with garlic inulin on the quality traits of chicken sausages. Inulin powder was prepared using garlic bulbs by hot water extraction, vaccum evaporation and spray drying. Chicken sausages were prepared using lean chicken meat with varying percentages (1%, 2% and 3%) (w/w) of garlic inulin or commercial inulin gradually replacing vegetable oil. Control was prepared using 3% (w/w) vegetable oil with no inulin. Physicochemical and sensory properties, microbial quality and TBARS value of prepared sausages were analyzed over a one-month under frozen storage. Sausages with 2% garlic inulin showed higher overall acceptability compared to all other samples ($p<0.05$). Ash, moisture and protein contents of the sausages were increased with the increasing level of inulin while, fat content was reduced from 13.67% to 4.47% ($p<0.05$) in 3% inulin incorporated product. Inulin incorporated sausages had lower lightness (L*) values than the control ($p<0.05$). Water holding capacity was not significantly ($p>0.05$) different among the samples. Cooking loss of inulin added samples were lower than the control ($p<0.05$). During storage L* value, pH, water holding capacity reduced while, redness (a*) and yellowness (b*) values and cooking loss increased in all the samples. In addition, no *Salmonella* and *Escherichia coli* were detected in any sample while, total plate count and TBARS values were increased during the storage in all samples within the acceptable limits. As conclusion, inulin can be successfully used as a fat substitute in sausage production.

Keywords: Garlic, Meat quality, TBARS, *Salmonella*, Fat substitute

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Effects of Protease and Viscozyme Enzymes on Physicochemical Properties of Cold-Water-Soluble Instant Black Tea

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Various enzymatic treatments have been invented for manufacturing cold-water soluble instant black tea. However, effects these treatments on physicochemical properties of cold-water-soluble instant black tea have not yet been studied in details. Therefore, this experiment was conducted to optimize the levels of protease and viscozyme enzymes for cold-water-soluble instant black tea manufacture and to investigate their effects on physicochemical properties of cold-water-soluble instant black tea. Samples of filtered hot water extract of black tea were treated separately with different levels of protease and viscozyme (0.1, 0.2, 0.3, 0.4, and 0.5%) based on the total solid in the extract maintaining the temperature at 45°C for 40 min. Then the samples were heated to 90°C and after cooling to room temperature they were centrifuged at 3,500 rpm for 10 min. Supernatants were analyzed for turbidity, color, brightness and total polyphenol content. Data were statistically analyzed by Duncun Multiple Range Test ($p<0.05$). This experiment was conducted in triplicates. Lower turbidity is always desirable in cold-water-soluble instant tea. Lowest turbidity levels were evident for both protease (12.79±5.08) and viscozyme (4.85±1.20) at 0.3% enzyme level. Total polyphenol content (g/100 mL) of protease treated sample (0.67±0.04) was not significantly different to that of viscozyme treated sample (0.64±0.02) whereas color and brightness of protease treated sample (9.12±0.98 and 15.34±1.47, respectively) were significantly higher than that of viscozyme treated sample (8.73±0.52 and 13.47±0.99, respectively). Nevertheless, turbidity of viscozyme treated sample (4.85±1.20) was significantly lower than that of protease treated sample (12.79±5.68). It can be concluded that protease can improve color and brightness of cold-water-soluble instant black tea and viscozyme is more effective in reducing turbidity.

Keywords: Cold-water-soluble instant tea, Protease, Viscozyme, Physical properties, Chemical properties

The Effect of Moisture Content of Desiccated Coconut on the Quality of Virgin Coconut Oil

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Virgin Coconut Oil (VCO) is one of the leading high value coconut products in the world. Present study aimed to evaluate the quality of VCO extracted from four different moisture contents (MC) ranges of desiccated coconut (DC): 1-1.5% (T0), 1.5-2% (T1), 2-2.5% (T2) and 2.5-3% (w/w) (T3), considering the, MC range (1-3% (w/w) of DC used to extract VCO. Freshly cut coconut kernels were dried in an oven at 60^{o}C for 1 hour and 25 minutes (T0), 1 hour and 30 minutes (T1), 1 hour and 45 minutes (T2) and 1 hour and 55 minutes (T3). MC of DC was tested. DC samples were fed into expeller machines (43^{o}C temperature and 1.5 bar pressure) to expel VCO. Four VCOs were kept for 10 days to sediment and tested for MC, free fatty acid (FFA) by titrating with NaOH and peroxide value (PV) by titrating with $Na_2S_2O_3$. Experimental design used was complete randomized design (CRD) and data were analysed using Minitab 16 statistical software. The average MC of DC of T0, T1, T2 and T3 were 1.13±0.01%, 1.74±0.05%, 2.31±0.25% and 2.74±0.24% (w/w), respectively. The average MC of VCO of T0, T1, T2 and T3 were 0.06±0.00%, 0.06±0.01%, 0.05±0.02% and 0.05±0.02% (w/w), respectively. PV of VCOs was ranged from 0.11 to 0.14 (meq peroxide kg^{-1} oil). The average FFA of VCO was ranged from 0.02-0.06 (mg NaOH g^{-1} oil). There is a positive correlation between MC of DC and MC of VCO (R^2=0.6141). But, there is no significant difference between MC, PV and FFA of four VCO samples. The MCs of VCO in this study were between 0.05% and 0.06% (w/w), which is within the value recommended by Asian and Pacific Coconut Community (APCC) (≤0.3% w/w). These findings ensure that the quality of VCO is not significantly change with MC of DC within the selected MC ranges.

Keywords: Peroxide value, Free fatty acid, Asian and Pacific coconut community

Development of Ginger (*Zingiber officinale*) Incorporated Functional Milk Dessert

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Starter cultures and stabilizers play a key role in making a stable coagulum in yoghurt manufacture. Ginger has high antioxidant capacity and unique ginger protease (GP) enzyme activity which can coagulate milk by affecting on milk caseins. This study was carried out to develop a functional dairy dessert coagulated by ginger juice (GJ) without adding starter cultures. GJ was prepared by blending fresh ginger without adding water followed by filtering. Standardized cow milk added with 8% sugar and 2% full cream milk powder was heated at 100ºC for 5 min and divided into two batches. One batch was incorporated with 2% gelatin and the other was prepared without adding gelatin. Each mix was cooled to 60ºC, added with varying amounts of GJ (0, 1, 3, and 5 %) separately and incubated at 60ºC for 2h to provide optimum temperature of GP activity and stored at 4ºC. Antioxidant activity (AO), total phenolic content (TPC) and total soluble sugar of fresh GJ were evaluated using DPPH, Folin-Ciocalteu and Phenol sulfuric methods, respectively. AO, pH, texture and TPC of the products were analyzed at 0, 3, 6 and 9 days of storage at 4ºC. Texture profile was analyzed using a texture analyzer. Total plate count, Yeast and mold, *Escherichia coli* counts were enumerated to determine the shelf life of the product. Sensory evaluation was done using 9-point hedonic scale, utilizing 30 untrained panelists. Ginger 1% product with gelatin was selected as the best in sensory evaluation. The product incorporated with 3% ginger with gelatin showed a significantly higher AO activity (61.81±6.96). There is no significant difference in TPC among the desserts. Ginger added product without gelatin showed a significantly higher hardness (86.33±16.6%) compared to 0% GJ added sample revealing the coagulating effect of GJ. However, increasing ginger percentage did not significantly ($p>0.05$) increase the hardness of the product. GJ can be used as a milk coagulant agent while improving the human health.

Keywords: Antioxidant activity, Coagulant, Texture, Total phenolic content

Effects of Tannase in Comparison to Viscozyme on Physicochemical Properties of Cold-Water-Soluble Instant Tea

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Developing turbidity in cold-water-soluble instant black tea is undesirable. Though varies enzymatic treatments have been invented to overcome this problem their effects on physicochemical properties of cold-water-soluble instant black tea are not known. This experiment was conducted to investigate the effects of optimized tannase and viscozyme enzymes treatments on physicochemical properties of cold-water-soluble instant black tea. Samples of hot water extract of black tea were treated separately with five different levels of tannase and viscozyme (0.1-0.5%) based on the total solid in the extract maintaining the temperature at 45ºC for 40 min. Then the samples were heated to 90ºC and after cooling to room temperature they were centrifuged at 3,500 rpm for 10 min. Supernatants were analyzed for turbidity, color, brightness and total polyphenol content. This experiment was repeated thrice. Data were statistically analyzed by performing Duncun Multiple Range Test ($P<0.05$). Lowest turbidity levels were evident for both Tannase (16.86±2.2) and Viscozyme (4.85±1.20) at 0.3% enzyme level. Total polyphenol content (g/100 mL) of tannase treated sample (0.78±0.13) was not significantly different to that of viscozyme treated sample (0.64±0.02). Color of tannase treated sample (10.10±0.61) was significantly higher than that of viscozyme treated sample (8.73±0.52) but its brightness (11.89±1.18) was significantly less than that of viscozyme treated sample (13.47±0.99). Nevertheless, turbidity of viscozyme treated sample (4.85±1.20) was significantly lower than that of tannase treated sample (16.87±2.45). It can be concluded that tannase can improve color of cold-water-soluble instant tea and viscozyme improves clarity of instant tea at 0.3% enzyme level. It should be further studied the potential of combine treatment of enzymes in improving overall physicochemical properties of cold-water-soluble instant tea.

Keywords: Tea cream, Instant Tea, Enzymatic treatment, Cold water solubility

Consumer Awareness Towards the Labeling Aspects on Beverage Products: A Case Study on the Beverage Products at Supermarkets-Chain in Matara Urban Area

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Food labelling is a tool which provides information on products' composition, quantity of content and nutritional profile to its consumers. If the ingredients exceed the required amount to be in a beverage, it will cause health hazards. For the prevalence of food safety, laws and regulations must be enforced to control the limits of ingredients incorporated. The objective of this study was to examine the awareness of consumers on food labeling regulations and other aspects while purchasing beverages at supermarkets chain in Matara urban area. The data were collected using convenience sampling technique and 200 consumers were interviewed with a pre-tested questionnaire. Descriptive statistical analysis and chi-square test were performed using SPSS statistical software. Results of descriptive statistical analysis revealed that majority of consumers (87.50%) were aware about the regulation on colour coding of sugar level. Consumers had less knowledge regarding the nutritional factors appeared on label and results indicated that awareness on sodium (24.50%), fat (23.50%), protein (22.50%), calories (13.00%) and ascorbic acid (7.00%). The majority of consumers were aware on quality standard; SLS (97.00%) while on other standards were low; HACCP (21.00%) and GMP (9.00%). Most of the consumers preferred to have light colour beverages (66.5%). Moreover, they mainly considered the price (94.00%), expiry date (89.00%) and brand name (79.50%) when purchasing beverages. The results of chi-square analysis revealed that educational level of the consumers was significantly associated with awareness of food labeling regulations ($p<0.05$). However, gender, age, income level and occupation were not significantly associated with food labeling regulations ($p>0.05$). In conclusion a compatible choice for beverages can be taken by paying attention to the food labeling regulations and other important aspects on the label.

Keywords: Quality standards, Beverage, Food labelling, Regulations, HACCP

Development of Rapid Dye Reduction (Resazurin) Test for Determination of Microbiological Quality of Coconut (*Cocos nucifera*) Water

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Traditional microbiological testing methods are labor-intensive and time-consuming. Rapid microbiological tests are very important in manufacturing establishments where quick decisions are required to be taken. Resazurin test is widely used as a rapid and easy method of determining the microbiological quality of milk. The aim of this study was to investigate the applicability of resazurin dye reduction test as a rapid test method to determine the microbiological quality of coconut (*Cocos nucifera*) water in a coconut water bottling plants. Fifty-five coconut water samples obtained from desiccated coconut mills were subjected to dye reduction test along with the total colony count by standard pour plate method. Samples represented microbial counts ranged from 5.8×10^5 to 2.65×10^7 CFU/mL and reduction times range from 3 min to 115 min. A correlation was established between resazurin dye reduction times (min) and the colony forming units per milliliter of coconut water samples. A strong correlation (-0.989) between variables was detected. Regression equation established between dye reduction time and total colony count was applied to predict the microbial quality of coconut water samples. A specific colour chart was developed by using standard colour codes to identify the initial colour and the end colour of the resazurin reduction test. Thus, it can be concluded that the resazurin rapid dye reduction test can be used to identify microbial quality of coconut water within shorter period of time.

Keywords: Coconut water, Colour chart, Microbial count, Resazurin test

Assessment of Composition and Functional Properties of Traditional Yam Varieties and Development of Value Added Muffins

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Sri Lanka has many underutilized yams with high nutritional potential. With the urbanization and changing food habits most of these underutilized yams have lost their significance. The objective of this study was to evaluate the composition and functional properties of five selected underutilized yam varieties in Sri Lanka; "Raja ala" (*Dioscorea alata*), "Kidaran ala" (*Amorphophallus campanulatus*), "Buthsarana-green" (*Canna indica*), "Buthsarana – red" (*Canna indica*), and "Katu ala" (*Dioscorea pentaphylla*). Moreover, their value addition was carried out with the development of gluten free muffins using "Raja ala" flour with food gums including pectin at the rate of 0.3% (w/w based on flour). The composition analysis was carried out to calculate the moisture content, crude protein content, total fat content and total ash content of the yam samples. Then, the texture profile of muffins were analyzed through the parameters hardness, deformation, adhesiveness, cohesiveness and springiness. The moisture content of "Raja ala" was the highest (7.75 ± 0.09%) and the lowest was recorded in "Buthsarana-red" (6.41 ± 0.04%). All five varieties were low in fat content and highest was recorded in "Raja ala" (1.09 ± 0.01%). The crude protein content of "Rala ala" and "Kidaran ala" were 4.28 ± 0.13%, 5.70 ± 0.11%, respectively. The highest ash content was recorded in "Kidaran ala" (4.711 ± 0.36%). Functional properties of the five varieties were illustrated by the water holding capacity and oil holding capacity. The highest oil holding capacity and the highest water holding capacity were recorded in "Kidaran ala" with values 77.04 ± 2.95% and 243.08 ± 2.56%, respectively. By incorporating pectin, gluten free muffins were prepared with "Raja ala" flour. According to the results, the hardness at cycle 1 and cycle 2 were 6065 g and 4335 g, respectively. Also the stringiness length, cohesiveness, adhesiveness and springiness were 14.63 mm, 0.31, 11.30 mJ and 36.46 mm, respectively.

Keywords: Underutilized yam, Composition, Functional properties, Muffins

Extraction of Anthocyanin from Hinembilla (*Antidesma alexiteria*) Fruit as a Natural Food Colorant

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Artificial food colorants impart health hazards thus, present study attempts to extract anthocyanin from Hinembilla (*Antidesma alexiteria*) fruit as a natural food colorant with promising antioxidant properties. Anthocyanin was extracted with ultrasound-assisted extraction (UAE) and maceration by using four different solvents (70% ethanol, acidified 70% ethanol, absolute ethanol and acidified absolute ethanol) at 40°*C.* Total monomeric anthocyanin (TMA) pigment content and total phenolic content (TPC) were determined by pH differential method and Folin-Ciocalteu method, respectively. Antioxidant efficacy of extracts were determined by ferric reducing antioxidant power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging capacity assays. TMA content ranged from 67.80 to 129.92 mg L^{-1}. DPPH radical scavenging activity as measured by IC_{50} ranged between 135.33 and 194.90 mg L^{-1}. FRAP ranged from 0.44 to 0.92 µmol Fe^{2+} per gram extract. TPC ranged from 3.33 to 6.77 mg gallic acid equivalents (GAE) per gram extract. Significantly ($p<0.05$) higher TMA (129.92 mg L^{-1}), FRAP (0.92 µmol Fe^{2+} per gram extract), TPC (6.77 mg GAE per gram extract) and lower IC_{50} (135.33 mg L^{-1}) values were recorded in UAE with 70% ethanol. Hence, anthocyanin can be extracted effectively with UAE than maceration with comparatively high antioxidant properties. Moreover 70% ethanol served as the best solvent to extract anthocyanin. The correlation of TPC with DPPH assay (IC_{50}) (R^2=0.7) and FRAP values (R^2=0.8) was strong, suggesting the phenolic compounds are the major contributor towards the exhibited properties. In conclusion, *A. alexiteria* serves as an excellent source of anthocyanin with high antioxidant properties thus suggesting the potential applications as a natural food colorant.

Keywords: Anthocyanin, *Antidesma alexiteria*, Maceration, Ultrasound-assisted extraction

Development of an Edible Film Using Coconut Protein Isolate

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Most of food products are covered by a packaging to separate it from the surrounding environment. There are several investigations on food packaging have shown that film forming ability of different plant proteins such as soy protein, mung bean protein, cowpea protein etc. This research was conducted to develop an edible film using coconut protein (CP) isolate from defatted coconut flour as an alternative for petroleum-based packaging materials. Coconut protein was isolated from the defatted coconut flour by alkaline extraction method. Extracted protein was dried using freeze drying and sieved through 800 µm mesh. Percentage of protein of the extracted powder was analyzed by Kjeldahl digestion method. Four different combinations of corn starch (3%, 2%, 1% and 0%) and coconut protein (0%, 1%, 2% and 3%) were used for film fabrication with two levels of pH (8.5 and 9.5) and two levels (2% and 0%) of polyethylene glycol (PEG) plasticizer. Casting technique was used for film preparation with 2% (w/v) glycerol and distilled water. The experiment was arranged as a three-factor factorial design with three replicates. Physical, chemical and optical quality characteristics (moisture %, swelling index, solubility, thickness, light transmission %) of edible films were evaluated. Data was analyzed by ANOVA ($p<0.05$) using MINITAB 16 software package. Results showed that, extracted CP has 78.43% of protein content. Combination of corn starch and CP were showed weaker film characteristics than pure treatments. CP films with 2.5% of PEG showed significantly ($p<0.05$) high moisture content (49.20% ± 0.43), swelling index (483.96% ± 13.79) in 8.5 pH and significantly high solubility (76. 0% ± 1.4) and thickness (0.33 ± 0.01 mm) in 9.5 pH. The pure corn starch film (pH 8.5 and 0% PEG) was showed significantly higher percentage of light transmission at 200 to 800 nm. In conclusion, coconut protein isolate can be effectively utilized as an edible food packaging material.

Keywords: Coconut protein isolate, Corn starch, Edible film, Polyethylene glycol

Comparison of Meat Quality Traits of Muscovy Duck Reared Under Different Management Systems

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Muscovy duck is a waterfowl commonly raised for meat production. Their carcass is leaner and has good meat qualities making it more preferable to the consumers. However, scientific literature on quality traits of their meat is not available in local context. Hence, this study was performed to compare the meat quality traits of Muscovy duck reared under extensive and semi-intensive systems. Nine female birds from each management system were randomly selected and slaughtered at 18 weeks of age. Meat samples from both breast and leg meat were analyzed for physicochemical (color, pH, water holding capacity [WHC], cooking loss, proximate analysis) and sensory properties. Sensory evaluation was conducted for grilled meat using a 7-point hedonic scale and 30 untrained panelists. Results revealed that the birds reared under semi-intensive system had significantly ($p<0.05$) higher live weight (1,966.7±216.0 g) and breast weight (444.9±33.1 g) than extensively reared birds. Meat from semi-intensively reared Muscovy ducks showed a higher redness (a*-14.42) than that from birds reared under extensive system ($p<0.05$). However, farming system had no significant effect ($p>0.05$) on lightness (L*) of Muscovy duck meat. Higher crude fat content, WHC and low pH were reported in semi-intensively reared Muscovy duck meat compared to those in extensively reared Muscovy duck meat. In comparison of meat cut, breast meat had a significantly higher lightness (L*-50.03) value while leg meat showed higher redness (a*-12.61) and pH (6.48) values. Cooking loss and ash content were not affected by management system or type of meat cut ($p>0.05$). Results of sensory analysis revealed that Muscovy duck meat from extensive management system had higher scores for taste, odour, flavour, juiciness, tenderness, and overall acceptability, irrespective of meat cut ($p<0.05$). In conclusion, meat quality traits of Muscovy duck were affected by both management system and meat cut.

Keywords: Muscovy duck, Extensive, Semi-intensive, Meat quality traits, Sensory

The Role of Natural Iron Chelators Incorporated to the Diet on Control of the Dietary Iron Contribution on Iron Overload through *in Vitro* Analysis

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There are many natural iron chelators found in food sources. The natural chelators can either increase or decrease the bio-availability of iron. The present study was carried out to assess the potential of incorporating food sources rich in natural iron chelators into the diets to reduce the dietary iron contribution for iron overload under *in vitro* conditions. The iron overload is the major cause of death in conditions such as thalassemia. Fifteen diet plans were formulated based on four ingredients namely, red rice, fresh milk, turmeric and black tea against a control diet. The designed diets were subjected to stimulated digestion and their effect on bio-availability of iron was tested using the Atomic Absorption Spectrometric method. The results showed that the bio-availability of the iron had comparatively reduced in all the diet plans except in one diet plan but that increase was not statistically significant ($p>0.05$). The diet containing combinations of turmeric, black tea and fresh milk showed the highest decrease (69.69%) in the iron bio-availability compared to the control. The results indicated that in the presence of lactoferrin in fresh milk, polyphenols in turmeric and black tea reduced the iron bioavailability in higher extent than when present alone as lactoferrin has a protective effect towards the polyphenols. As the incorporation of natural iron chelators significantly reduced the *in vitro* iron bioavailability in the diets ($p<0.05$), it can be concluded that contribution of dietary iron towards the iron overload condition can be controlled by incorporating natural iron chelators to the diet.

Keywords: Iron bioavailability, Iron overload, Natural chelators, Stimulating gastro intestinal conditions

Effect of Hinembilla (*Antidesma alexiteria*) Extract on Oxidative Stability of Selected Edible Oils

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Oxidation of oil is a major challenge in food processing sector which leads to deterioration of quality. Though, synthetic antioxidants are effective in preventing rancidity of oils, these substances show adverse health effects. Thus, the present study aimed to utilize natural antioxidant extracted from Hinembilla (*Antidesma alexiteria*) to retard the rancidity of selected edible oils. Extract was prepared with 70% ethanol using ultrasound-assisted extraction. The antioxidant efficacy of extract was measured using 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging capacity and Folin-Ciocalteu method was used to measure total phenolic content (TPC). Free fatty acid (FFA) content and peroxide value (PV) of sunflower oil (SO) and virgin coconut oil (VCO) were measured at 3-day intervals after addition of extract at three different concentration levels *viz* 500, 1,000, and 2,000 ppm, and α-tocopherol (500 ppm) was used as the positive control and the experiment was continued for 21days at 65±1°C. Antioxidant activity (IC_{50}) and TPC of the extract were 135.33±4.49 µg mL^{-1} and 6.77±0.03 mg GAE per gram extract, respectively. FFA content and PV of both oils were increased with the time. FFA content and PV of SO (FFA:0.14%; PV:12.23 meq kg^{-1}) and VCO (FFA:0.22%; PV:1.19 meq kg^{-1}) added with extract at 2,000 ppm were significantly lower ($p<0.05$) than those of positive control; SO with α-tocopherol (FFA:0.22%, PV:17.94 meq kg^{-1}) and VCO with α-tocopherol (FFA:0.29%, PV:1.39 meq kg^{-1}) after 21 days. In conclusion, Hinembilla extract had a positive impact on oxidative stability of selected oils at 1,000 and 2,000 ppm levels. Hence, *A. alexiteria* fruit is an excellent antioxidant source which can be effectively used to stabilize the oxidation of edible oils.

Keywords: Antioxidant, Free fatty acid, Peroxide value, DPPH, Virgin coconut oil

Extending Shelf Life of Tomatoes Using Microbial Antagonists

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The current methods used to extend the shelf life of tomatoes are expensive and toxic, thus inexpensive and nontoxic methods are required to extend their shelf life. Objective of this study was to extend the shelf life of tomatoes using fruit peel extracts. Peel extracts were prepared from sweet orange (*Citrus sinensis*), lime (*Citrus aurantiifolia*) and sour orange (*Citrus aurantium*) peel using a rotary evaporator.From the extracts 2.5 mg mL^{-1}, 1.25 mg mL^{-1} and 0.625 mg mL^{-1} concentration series were prepared. Most abundant microbial species were isolated from rotten tomatoes and tentatively identified as *Bacillus* sp. and *Penicillium* sp. The antimicrobial activities of three peel extracts were tested by using agar well diffusion assay. Positive controls for bacteria and fungi were Amoxicillin and Fluconazole, respectively, and 50% ethanol was the negative control. There were significant differences between Mean Inhibition Zone Diameters (MID) of different concentrations ($P<0.05$). Both concentration and type of extract significantly affected for MID ($P<0.05$). Although the highest MID was resulted from positive controls (2.6±0.3 cm, 3.4±0.4 cm for Amoxicillin and Fluconazole, respectively), sweet orange peel extracts had shown highest MID of 2.5±0.8 cm and 2.1±0.3 cm (at 2.5 mg mL^{-1}) for both bacteria and fungi, respectively, compared to other peel extracts. A solution of sweet orange peel extracts (2.5 mg mL^{-1}) was then prepared and sprayed on a batch of tomatoes (ripen) belonging to same variety and same size, while Amoxicillin and Fluconazole solution and distilled water were sprayed on another three batches of tomatoes. The shelf life of sweet orange peel extract solution sprayed batch was 26 days in average while that of batches sprayed with Amoxicillin, Fluconazole and water were 19, 20 and 5 days in average, respectively. Therefore, sweet orange peel extracts could be used to prepare antimicrobial solutions to extend the shelf life of tomatoes.

Keywords: Tomato, Citrus peel extracts, *Bacillus* sp., *Penicillium* sp., Shelf life

Nutritional, Physicochemical and Sensory Properties of *Embul* Banana (*Musa acuminata AAB*) Snack Developed using Vacuum Dehydration

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A great potential exists for *Embul* Banana (*Musa acuminata AAB*) value added products due to its limited preservation methods and proven health benefits. This study focused on development of *Embul* banana snacks using vacuum dehydration. Vacuum dehydrated *Embul* banana snacks were packed using 300 µ High Density Polypropylene bags and stored in a cool and dry place for two months. Proximate composition of the final product was determined using AOAC methods. As microbiological properties total plate count, yeast and mold count and *Escherichia coli* were checked during the storage. Sensory data obtained monthly by 9-point hedonic scale were analyzed using Kruskal Wallis non parametric test in MINITAB 16. Developed snack sample contained 0.87±0.005% moisture, 5.2±0.01% crude fiber, 0.3±0.01% free fat, 15.4±0.01% protein, and 3.2±0.01% ash. Sensory evaluation revealed that there were no significant changes ($P > 0.05$) in any sensory attribute (color, aroma, taste, mouth feel, texture and overall acceptability) throughout the storage period. Physicochemical properties such as pH, firmness, total soluble solids, moisture% and ascorbic acid content of the final product were 5.12±0.005, 4.26±0.50 Kg, 6.0±0.0%, 0.87±0.005% and 10.79±0.005 mg $100g^{-1}$, respectively. Total phenolic content determined by Folin-Ciocalteau method for the final product was 281.86±1.18 mg GAE $100g^{-1}$ while IC_{50} value determined from the DPPH radical scavenging assay for the final product was 234.06±1.03 mg mL^{-1}. Total plate count was less than 10^1 CFU g^{-1} while yeast and mold counts were less than 10^3 CFU g^{-1} which ensures that the product is within the international limits stipulated by World Health Organization. *E. coli* were not detected even after two months. Developed vacuum dehydrated *Embul* banana snacks can be safely stored under room temperature for two months.

Keywords: Banana snacks, Proximate analysis, Sensory evaluation, Shelf life, Vacuum dehydration

Development of a Functional Butter Incorporated with Red Onion (*Allium cepa)* or Garlic (*Allium sativum*) Powder

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Butter is a versatile, high fat dairy product which can be improved to a functional food with natural antioxidants that can cater the consumers who prefer nutritious foods. Thus, the present study investigated the use of red onion and garlic as natural antioxidants in developing a functional butter. Garlic and red onion powders were prepared by oven drying (60°C for 24h) and incorporated into the butter during working at the ratio of 2%, 4% and 6% (w/w) to prepare treatments. Butter without addition of onion powder was used as the control. The sensory evaluation was done using 30 untrained panelists with 9-point hedonic scale. Radical Scavenging Activity (RSA), total phenolic content, soluble sugar content of red onion and garlic powders were evaluated using DPPH method, Folin-ciocalteu method (FC) and phenol sulfuric methods respectively. Water activity of powders and moisture and ash content of butter samples were analyzed. Free fatty acid, peroxide value, microbiology (Yeast and mold, total plate count) parameters were evaluated in 1st, 7th, 14th, 21th and 28th day intervals during refrigerated storage. RSA of red onion powder was significantly higher (87.65±0.45%) compared to that of garlic powder (16.20±0.45%). Garlic 4% (w/w) and red onion 4% (w/w) incorporated butter were selected as the most consumer preferred samples among the treatments. RSA of 4% red onion incorporated butter was significantly higher (89.46±0.20%) compared to that of 4% garlic incorporated butter (60.04±0.20%) at 0th day at refrigerated storage. The control showed significantly lower RSA (38.24±0.23%) among all treatments ($P<0.05$). Results of the study revealed that functional butter with high RSA can be developed incorporating red onion powder.

Keywords: Antioxidants, DPPH, Functional butter, Red onion, Garlic

Development of Nelli (*Phyllanthus emblica*) Powder Incorporated Instant Rasam Mixture and Evaluation of Its Sensory, Physicochemical and Microbial Properties

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Nelli (*Phyllanthus emblica*) is one of the underutilized, seasonal fruit crops which contains higher amount of vitamin C as well as other vitamins and minerals. However, due to lack of awareness on its nutritional composition, astringent and bitter taste of the fruit, usage of it for developing food products is in low level. Therefore, this study was conducted to develop a value added product from *Nelli. Nelli* powder incorporated instant *rasam* mixture was prepared by mixing 30 % (w/w) of *Nelli* powder with 70% (w/w) of dehydrated powders of the usual ingredients of traditional *rasam*. For select that ingredient combination, preliminary studies and several sensory evaluations were carried out. Sensory evaluations were carried out using 9-point hedonic scale by 30 panelists and considered sensory parameters were aroma, taste, color and overall acceptability. Sensory data were analyzed by Friedman test using MINITAB 18 statistical software. Developed product was packed in metalized film pouches. Storage life of the product was evaluated up to 2 months at ambient temperature. Proximate analysis was done and resulted values for moisture, total fat, crude fiber, total ash and crude protein contents were 5.33±0.03%, 2.17±0.23%, 8.52±0.18%, 3.18±0.06%, 9.17±0.65% respectively. Ascorbic acid was determined as it is the main constituent presence in *Nelli*, and it results significant reduction ($p<0.000$) during the storage period. According to the microbiological results product was microbiologically safe for consumption up to 2 months of storage period. This study provides potential on developing value added products from *Nelli*.

Keywords: Nelli, Rasam, Storage life

Production and Shelf Life Evaluation of Nutritious Jam Using Underutilized Bael (*Aegle marmelos* L.) Fruit

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Bael (*Aegle marmelos* L.) fruit is a rich source of nutrients, including dietary fiber, vitamin C, folate, potassium, phyto-nutrients and many antioxidants such as phenols and flavonoids. They are naturally low in fat, sodium, calories and have no cholesterol. Jams are one of the most popular food products because of their low cost, all year long availability and sensory properties. The present study was aimed to develop nutritious jam from Bael fruit pulp and to assess its quality, stability and suitability during storage. Bael fruit jam was prepared according to the Sri Lankan Standard Specification for jam using a general recipe. The nutritional, phytochemical, microbiological and sensory evaluations were assessed up to 3 months of storage at 28-30°C and 80-90% relative humidity. The nutritional parameters were analyzed according to the Standard AOAC methods. Sensory attributes of colour, aroma, taste, spreadability and overall acceptability were evaluated with 30 semi-trained panelists using a 7-point hedonic scale. The results were subjected to statistical analysis using analysis of variance technique and comparison of means by LSD test. The bael fruit jam contained 69.27% total carbohydrates, 30.26% moisture, 0.91% protein, 0.47% ash, 1.83% dietary fiber, 35.5 mg% ascorbic acid, 0.46% titratable acidity, 61.2% total soluble solids (°Brix) and 3.47 pH. The total soluble solids, titratable acidity and pH were not significantly changed during storage period of 3 months ($p>0.05$) however ascorbic acid, polyphenol content and antioxidant activity significantly decreased ($p<0.05$). The total plate, yeast, mold counts were less than the standard maximum permissible limits. Sensory assessments revealed that texture of the bael jam significantly changeed and became soft on storage. Based on the quality assessment, the bael fruit jam production proved to be feasible and certainly is an option for the consumption of underutilized fruits for greater shelf life.

Keywords: Bael fruit, Jam, Phytochemical properties, Quality assessment, Shelf life

Characterization of Flour from Sri Lankan Cassava (*Manihot esculenta*) Cultivars

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Cassava is an important crop for low income families in Sri Lanka to consume as boiled or fried roots. It is a good source for product diversification in food industry. Thus, present study was a preliminary investigation to produce flour from Sri Lankan cassava cultivars to be used as a raw material in food industry. Roots of Suranimala, Swarana, Shani, MU-51 and Kirikawadi cultivars were harvested, cleaned and thoroughly mixed with water in an open vessel for 5 h at 30^{o}C. Slices were dehydrated at 50^{o}C for 20 hours, ground and passed through a 0.250 mm sieve to obtain flour. Flour was placed in poly-nylon plastic vacuum bags and stored at room temperature. The shape, size and color of the starch granules, and nutritional composition and total phenolic contents were analyzed. Size of starch granules ranged between 12.79 µm to 14.85 µm and there was no significant difference ($p>0.05$) between the sizes of starch granules and they were polygonal in shape, homogeneous and there were no any holes on the surfaces. The lightness, red/green coordinate and yellow/blue coordinate of flour were significantly different ($p<0.05$) to each other. Maximum ash content of 2.06±0.01% was reported in Suranimala while Kirikawadi had minimum ash content of 1.12±0.02%. Ash contents had significant differences between them. Maximum fat content of 0.64±0.12 % was found in Suranimala cultivar and minimum fat content of 0.21±0.06 % was reported by MU 51. There was a significant difference between fat contents of flour ($p<0.05$). Protein contents were ranged between 1.09±0.22 % to 1.70±0.03% and there was a significant difference ($p<0.05$) between protein contents. Total phenolic contents were determined according to the Folin Ciocalteu method and ranged between 2.69±0.21 to 4.45±0.08 (mmol GAE/100 dry weight). There was a significant difference ($p<0.05$) between phenolic contents of cultivars. Present findings helped to differentiate flour from five cassava cultivars and provided basic information about their potential to be used as a raw material in food industry.

Keywords: Cassava, Cultivars, Flour, Composition, Phenolic content

Minimizing the Postharvest Losses of Avocado (*Persia americana*) by Determining the Maturity Indices

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The avocado (Persia americana) fruit is a climacteric fruit which exhibits high postharvest respiration and limited shelf life. It is difficult to determine the proper maturity stage of avocados by observing the fruits externally. Identification of proper maturity level can minimize the postharvest loss in avocados and ensure better quality in commercial purchasing. The aim of this study was to minimize the postharvest losses in avocado at the retail chain pack- house by determining the maturity indices and to identify the maturity stage of avocados for commercial purpose. Avocado variety Pollock fruits were purchased from selected suppliers in Matale and Kandy areas. The fruits were categorized and scaled based on the maturity/ripening stage by manual pressing. A maturation scales (1-4) of avocados was used: 1-raw, 2-moderately ripen, 3-ripen and 4-over ripen. Fruits were analyzed for physiochemical parameters: dry matter content (DMC), electrical conductivity (EC), fat content (FC), density and total soluble solid (TSS). Results showed an increasing trend in both DMC and EC related to avocado maturity and there was positive correlation between EC and DMC of avocado pulp (r=0.8503), which is expressed by regression equation y = 98.741x + 321.33. DMC and FC also had a high positive correlation (r=0.9086) and there was no any strong correlation between both avocado density (r=0.0759) and TSS (0.2896) with DMC. Therefore, DMC, EC and FC can be used as maturity indices of Pollock avocado fruits in commercial purchasing which at the range of (18-21%) DMC, (2100-2400 µSicm-1) EC and (6.9-7.9%) FC. Hence, the postharvest loss of avocado variety Pollock can be minimized by the use of maturity indices of DMC, EC and FC.

Keywords: Avocado, Maturity indices, Postharvest losses, Physiochemical parameters, Climacteric fruit

Preparation and Quality Evaluation of Soursop (*Annona muricata* L.) Jelly without Preservatives

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Soursop fruit has a great potential to ensure food security, nutrition and income generation. The fruit has been used as a natural medicinal remedy for many years worldwide and it has a broad range of therapeutic effects, including antibacterial, antitumor, analgesic, hypotensive, anti-inflammatory and immune enhancing properties. Therefore, nowadays most food processing industries move to preparation of various value added products using soursop fruits. Fruit jelly is a semi-solid gelled made from the juice, mixed with acids, pectin and sweetening agents. This study was focused to develop a soursop jelly and to assess its sensory qualities, physico-chemical properties and storage stability. Soursop jelly was prepared according to Sri Lankan Standard Specification of a general recipe for fruit jelly. Physico-chemical characteristics, organoleptic qualities and microbial studies were carried out following different formulation of jellies. Total plate count was carried out for microbial studies and seven points hedonic scale was used to assess the sensory attributes. The nutritional analysis of the freshly made jelly revealed that the titratable acidity, TSS and total sugar increased from 0.32 to 0.52%, 5.1 to 21.17 (°Brix) and 40.58 to 82.4% while the moisture and pH decreased from 36.4 to 22.21% and 4.33 to 3.85, respectively, with increase in soursop pulp concentration from 20 to 100%. According to Tukey's test, the mean scores for the assessed sensory characters varied significantly in the freshly made jelly ($p<0.05$) and the highest overall acceptability was recorded with 80% soursop pulp concentration. No total plate count was observed in all formulated jellies. Based on the results, the jelly made with 80% soursop pulp was selected as best formulation and could be stored at 30°C and 80-90% RH for 12 weeks without any significant changes in the quality attributes. In conclusion, preparing jelly is an ideal way of adding value to the underutilized soursop fruit.

Keywords: Fruit jelly, Physico-chemical parameters, Sensory evaluation, Soursop

Determination of Nitrate and Nitrite Concentrations in Commercially Available Sausage Products from Small–Scale Retailers in Kandy Area

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Nitrates and nitrites are found in many foods which people may consume on a daily basis. In processed meat products, nitrate and nitrite salts are widely used as preservatives, antioxidants, flavor enhancers and color stabilizing agents. But the presence of excessive nitrates and nitrites can have toxic and carcinogenic effects on humans. Hence, the concentrations of nitrates and nitrites in food need to be monitored to ensure the quality and safety of meat products. This study was aimed to investigate the Nitrate and Nitrite content of frequently consumed sausage samples in Kandy area. The samples were collected from 10 different small-scale retailers' stores and supermarkets in the area, over a period of 7 months from May, 2018 to November, 2018. To determine the nitrate and nitrite concentrations, Suppressed Ion Chromatographic (IC) technique was used following the extraction and protein precipitation procedures. According to the results obtained, the average nitrite and nitrate concentration levels in small-scale retailers' uncooked samples were 60-85 mg kg^{-1} and 90-150 mg kg^{-1}, respectively. Average nitrite and nitrate levels in small-scale retailers' cooked samples were 55-75 mg kg^{-1} and 70-105 mg kg^{-1}, respectively. For selected branded samples nitrite and nitrate levels were 40-55 mg kg^{-1} and 60-80 mg kg^{-1}, respectively. According to the results, for small-scale retailers' uncooked samples, nitrate levels exceeded the acceptable nitrate levels according to the Sri Lankan standards (125 mg kg^{-1}). These excessive levels of nitrates, can act as a reservoir for nitrites. Therefore, it is necessary to regulate nitrate and nitrite levels in sausage products manufactured by small scale retailers in Kandy area.

Keywords: Nitrate, Nitrite, Ion chromatography, Sausages

Characterization of Physical and Chemical Properties of Selected Vegetables Under Modified Storage Condition

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Minimizing the postharvest losses will be a sustainable solution to increase the food availability which could meet the requirement for food by growing population. In Sri Lankan context, perishable vegetables are stored throughout the postharvest chain without using proper storage facilities which resulted 30-40 % postharvest losses annually. Thus this study was aimed to extend the postharvest life of selected vegetable using modified storage conditions such as 65% relative humidity (RH) with 20-22°C temperature. Potato (Solanum tuberosum), Beetroot (Beta vulgaris L.), Knol kohl (Brassica oleracea var. gongylodes), Carrot (Daucus carota L.), Beans (Phaseolous vulgaris L.), Lettuce (Lactuca sativa), Mentha leaves (Mentha spicata) and Coriander leaves (Coriandrum sativum) were selected for the study. Temperature (20-22°C) was controlled using air conditioner and relative humidity (65%) was maintained by manually operated humidifier. The ambient condition served as the control. Firmness, brix, pH, percentage weight loss (in percentage) and surface colour were evaluated in five days. In modified storage condition, Potato, Knol khol and Carrot have shown same firmness as initial condition after five days of storage. Potato, Beetroot, Lettuce and Mentha leaves showed continuously increase significant brix value during storage. Beetroot and Beans showed the best performance under modified storage condition with regards to pH value. All vegetables showed the highest weight loss at ambient condition. Carrot turned into dark colour at modified storage, but Mentha leaves and Coriander leaves did not show any colour change. Knol khol is not changing in colour during modified storage condition. After considering all parameters, in 65% RH vegetables can be stored without losing their quality when considering five days' storage.

Keywords: Postharvest loss, Modified atmosphere storage

Identification of Physiochemical Properties of Nas Naaran (*Citrus madurensis*) in Different Maturity Stages

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Nas Naaran (*Citrus madurensis*) is a tropical tree which belongs to the family of *Rutaceae*. The tree contains fruits rich in vitamin C, phenolic compounds and other nutrients yet there is no scientific research on the physiochemical properties of the fruit. In this study the physiochemical properties of the Nas Naaran fruit in four different maturity stages (MS) were evaluated. MS one is considered as the immature fruit with green color skin and the MS four was considered as fruits with yellow color skin and fully matured. Ten fruits from each MS were used for the study. The size of the fruit, pH value, total soluble solids (TSS), vitamin C content, fructose content, and total phenolic content were evaluated. The length and the diameter of ten fruits from each MS were measured. The pH value was measured using a pH meter, TSS value was measured using a digital refractometer, Vitamin C content was measured by a Spectrophotometric method, Total phenolic content and fructose content were measured according to standard procedures. The diameter of the fruit was increased when the fruit matured. The highest pH was observed as 5.34 in MS one. The pH value was decreased as the fruit matured. TSS value was increased when the fruit matured. The highest TSS value was observed in MS four as 7.1. The fructose content was increased with MS. The highest fructose content was observed as 229.52 ppm in stage four. The vitamin C content was decreased as the fruit matured. MS three contained the highest vitamin C content of 25.10 ppm. The total polyphenol content was decreased as the fruit matured. The highest total polyphenol content was observed in the second MS as 31.31 mg ml^{-1}. The physiochemical properties of Nas Naaran varies significantly ($p<0.05$) within maturity stages.

Keywords: Nas Naaran, Maturity stages, Physiochemical properties

Comparison of ABTS, DPPH, and FRAP Assays for Estimating Antioxidant Potential of Selected Sri Lankan Traditional Sweetmeats

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Fifteen Sri Lankan traditional sweetmeats (Hendi kewum, Beraliya kewum, Naran kewum, Athirasa, Mung kewum, Aasmi, Kokis, Undu walalu, Welithalapa, Bedihaalpiti aggala, Dodol, Aluwa, Thala guli, Kurahan helapa and Pusnambu) were investigated for antioxidant potential (AP) by 2,2-diphenyl-1- picrylhydrazyl assay (DPPH), 2,2-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid (ABTS) assay and Ferrous reducing antioxidant power assay (FRAP). Total phenolic content (TPC) and total flavonoid content (TFC) of sweetmeats were determined by using colorimetric assays. Lyophilized sweetmeats (1:10) were used to prepare 80% methanolic extractions at room temperature for 24 hours for all the assays. Helapa was further investigated for the changes in AP with the changes of ingredients utilized in different regions of Sri Lanka. Accordingly, Helapa prepared with 100% finger millet flour, finger millet+rice flour, Shorea megistophylla (sin. Beraliya) flour+rice flour, Vateria copallifera (sin. Hal) flour+rice flour, Madhuca longifolia (sin. Mee) flour+rice flour was studied. Results revealed that, among sweetmeats examined for AP, Naran Kewum showed the significantly highest AP (1595.7±0.03 µg/mL TE) by FRAP assay and Helapa showed the highest radical scavenging activity for DPPH (564.8± 0.02 µg/mL TE) and ABTS (553.2±0.01 µg/mL TE) assays ($p<0.05$). Naran Kewum showed the significantly highest TPC (293.44 GAE/100 g) and TFC (237.8±0.34 QE/100g). In addition, rice flour mixed with Shorea megistophylla flour in preparation of Helapa had the highest TPC (316.9±0.28 GAE/100 g), the highest radical scavenging activity for DPPH (541.6±0.67 µg/mL TE) and ABTS (502.6±0.21 µg/mL TE) assays ($p<0.05$) with compared to other ingredients added Helapa. These AP may be due to stable polyphenolics at high temperatures and newly formulated molecules by Maillard reaction. It is apparent that, Sri Lankan traditional sweetmeats had significant AP which are related with positive health benefits.

Keywords: Traditional sweetmeats, Antioxidant potential, Phenolic content, Health benefits

Flour Properties of Selected Traditional Yam Varieties and Development of Gluten Free Muffins from "Maha angili ala" (*Dioscorea alata*) Flour

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In the present study, physico-chemical properties of flour obtained from four varieties of traditional and underutilized yams such as, *Dioscorea alata* ("Hingurala" and "Maha angili ala"), *Dioscorea esculenta* ("Kukulala") and *Dioscorea bulbilifera* ("Udala") were investigated. Moreover, a gluten-free muffin was developed from "Maha angili ala" flour incorporating pectin, guar gum and xanthan separately for the first time in Sri Lanka. Proximate analysis conducted according to the AOAC procedures revealed that the moisture contents of four varieties were in between 4.94 ± 0.11% to 5.89 ± 0.11%, fat contents were ranged from 0.55 ± 0.18% to 0.84 ± 0.45%, protein contents were in between 4.53 ± 0.55% to 4.99 ± 0.29% and ash content ranged from 2.39 ± 0.18% to 3.52 ± 0.18%. The color values L^*, a^*, b^* obtained from colorimeter were ranged from 54.06 ± 1.56 to 85.19 ± 2.14, 1.74 ± 0.33 to 10.92 ± 1.24 and 7.82 ± 0.33 to 28.33 ± 0.86, respectively. Moisture, fat, protein and ash contents of pectin, guar gum and xanthan incorporated muffins were 77.67 ± 0.53%, 82.91 ± 0.24%, 81.23 ± 0.78%, 12.25 ± 1.11%, 17.54 ± 1.93%, 11.99 ± 2.24%, 6.13 ± 0.17%, 5.72 ± 0.05%, 16.75 ± 0.19%, 2.75 ± 0.12%, 3.65 ± 0.06% and 1.93 ± 0.14%, respectively. L^*, a^*, b^* values of three type of muffins ranged from 27.69 ± 1.13 to 31.92 ± 0.65, 12.22 ± 1.34 to 13.54 ± 1.16 and 12.11 ± 1.15 to 13.46 ± 2.32, respectively. The microscopic observation of flours revealed that the granular shapes of four varieties, "Hingurala" and "Maha angili ala" had oval shaped granules. In addition, the granular shape of "Kukulala" was polygonal and "Udala" contained coma shaped granules. Smallest granular shape was observed from "Kukulala". Collectively, this study suggested that "Maha angili ala" flour could be a potential source to develop gluten free muffins and analysis of the product quality parameters of the muffins are in progress.

Keywords: Muffins, *Dioscorea* spp., Gluten-free foods, Traditional yams, "Maha angili ala"

Evaluation of Nutritional, Physiochemical and Technological Properties of Flour Made from Canistel Fruit (*Pouteria campechiana*)

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Fruits are important in human diet as they provide essential nutrients such as vitamin, minerals and fibers. Most of fruits are seasonal and highly perishable. Therefore, various preservation techniques are used to prolong their shelf life. Canistel fruit is a seasonal, perishable and underutilized fruit and it can be a cheap source of macro and micro nutrients as protein, fiber, niacin, carotene (pro-vitamin A) and ascorbic acid. Further, various health benefits are also reported due to the presence of functional compounds in it. Therefore, this study was focused on developing a flour from Canistel fruit and checking the possibility of utilizing it as a food ingredient particularly in bakery industry. According to the previous study, oven drying method ($60^0$for hours) was practiced for flour preparation. Wheat flour is major flour use in bakery industry. Therefore, wheat flour was used as the control. Physiochemical and technological properties including swelling capacity, water absorption capacity, oil absorption capacity, emulsion activity, emulsion stability, foam capacity, foam stability, gelatinization temperature, least gelation concentration, bulk density and proximate composition were determined. Results showed that Canistel fruit flour having appropriate gelation properties (Least gelatinization concentration was 4% and Gelatinization temperature was67^0C), swelling capacity (13ml), water absorption capacity (119%), oil absorption capacity (198%).Cake and cookies were made by using canistel fruit flour.

Keywords: Bakery industry, Canistel fruit flour, Wheat flour, Physiochemical properties, Gelation

Development of Food Colorant Using *Hibiscus rosa-sinensis* that can Be Used for Beverages

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Natural food colorants have been demanded and become increasingly popular among consumers because of their safety, and health benefits. In this study, brilliant red color *Hibiscus rosa-sinensis* flowers were used to develop a powder food colorant for beverages. For the development, flower petals were blended with distilled water. The liquid of petals was filtered and dried using an oven to take powder form of colorant. The further study was undertaken to measure the quality of developed colorant and identify the colorant affection for the beverage products. During the measurements, glass bottles, plastic bottles, and polythene bags were used as storing packages and 3 packages from each package were kept at 27, 18, and 4^{o}C. Cytotoxicity analysis has resulted as zero death of brine shrimps within 24 hours. pH differences in beverages were not found out after adding the colorant. However, colorant pH was not stable with acid and base solutions. The colorant initial maroon color changed into red with HCl and it changed into dark blue with NaOH. The confirmative test resulted presence of anthocyanin in the colorant. Out of the responses of two sensory evaluations for watermelon juice and lemon juice, responses were in favor of the colorant added juice. The highest solubility of the colorant showed in water at 70^{o}C. The freshly made dried powder form of the colorant was almost microbe-free. Shelf life was analyzed with the total plate count with the different packages stored in above-mentioned temperatures. Colorant kept in a glass bottle at 4^{o}C displayed the lowest total plate count within three weeks. During a three weeks storage period at 25^{o}C, the spectra absorption of the colorant was decreased. The developed colorant (0.6 g) dissolved in 10 ml of distilled water was approximately similar to the synthetic food colorant absorbance. These findings may emphasize that developed colorant can replace the synthetic food colorant.

Keywords: Hibiscus, Colorant, Sensory, Quality, Shelf life

Evaluation of Physicochemical Properties, Proximate Composition and Antioxidant Activity of Selected Underutilized Fruit Species

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Underutilized fruits are less known due to the commercialization of few, selected fruit crops. Recent studies have suggested that these underutilized fruits possess many health benefiting compounds such as cancer fighting antioxidants and phenolic compounds. However, detailed studies on underutilized local fruits to establish their usefulness as fruit crops are lacking. The main objective of this study was to determine the antioxidant activity, total phenolic content (TPC), proximate composition and physiochemical properties of four selected underutilized fruits namely, *Sonneratia caseolaris* (Kirala), *Annona reticulata* (Weli Anoda), *Prunus persica* (Peach), and *Psidium cattleianum* (Jam Pera). All experiments were done using standard methods. Antioxidant activity was determined by using DPPH and ABTS scavenging methods. The percentage of inhibition and IC_{50} were measured in both assays. The total phenolic content of the extracts was determined using the Folin-Ciocalteu Reactifi (FCR) method and calculated as mg Gallic acid equivalent (GAE) g^{-1} extract. Among the analyzed fruits, maximum amount of moisture was found in *P. persica* (88.00±0.18). *P. cattleianum* showed the highest ash and fat content among the selected fruit species. The highest ascorbic acid content was found in *S. caseolaris* (0.24±0.01) while *P. persica* showed the lowest (0.06±0.001). In DPPH and ABTS assays, the lowest IC_{50} was showed by *S. caseolaris* (40.80 µg ml^{-1} and 99.85±3.67, respectively). The highest and the lowest phenolic contents were found in *S. caseolaris* (0.85±0.01 mg GAE g^{-1}) and *A. reticulata* (0.17±0.00289 mg GAE g^{-1}), respectively. The results indicated that *S. caseolaris* can be considered as the best fruit to consume as it contains high amount of antioxidants. All selected underutilized fruits contained appreciable amounts of compounds which could provide health benefits and could be used in food and pharmaceutical industries.

Keywords: Underutilized local fruits, Proximate analysis, Antioxidant assay, Total phenolic content.

Formulation of Orange-fleshed Sweet Potato (*Ipomoea batatas*) Puree Incorporated Ice Cream

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Orange Fleshed sweet potato is a cheap and abundant yet underutilized root crop in Sri Lanka. Even though functional and nutritional benefits of sweet potato were reported by many studies, scanty of value added products are found in the local market. Further, ice cream is a popular dairy product which can be utilized as an excellent carrier to deliver these nutritional and functional benefits of sweet potato. Therefore, the objective of this study is to formulate sweet potato incorporated ice cream along with probiotic culture BB12. For this purpose, three ice-cream formulations were prepared by replacing cows' milk with sweet potato puree (10%, 20% and 30%). Textural properties of newly formulated ice cream were evaluated with compared to commercially available product by using Brookfield texture analyzer. Consumer preferences for the three ice cream formulations were evaluated using 9 point hedonic scale with 37 applicants and the data were statistically analyzed. The results showed that textural properties of all three formulations were largely deviate from commercially available samples. Ice cream formulation which added 20% sweet potato puree was the best accepted for color, flavor, odor, texture and overall acceptability. 103.6% over run was obtained for most preferred ice cream sample. The estimated shelf life of the product was approximately 4-5 weeks.

Keywords: Consumer preference**,** Ice cream, Orange-fleshed sweet potato, Textural properties

Consumer Awareness and Perception on Highly Processed Food Products Available in Sri Lanka

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Highly processed food products are popular in modern world. There is a worldwide discussion regarding their positive and negative effects on human health. However, the studies on awareness, acceptance and misbelieves of these food products are less in Sri Lanka. Therefore, this study was focused on consumer awareness and perception on highly processed foods available in Sri Lanka. Randomly selected 500 respondents from all over the country were interviewed using a structured questionnaire that was designed to obtain information on the general awareness and perception and factors influencing their buying behavior. Demographic information and occupation were collected to identify their effect on awareness and perception of highly processed foods. Respondents were also asked to state the level of perception of the family members. Results revealed that 74% of the respondents had awareness on highly processed foods. Highest awareness (95%) was observed in Colombo and Kalutara districts. Respondents below 45 years had approximately higher awareness than those above 45 years. Highest positive perception was observed among children in their families. According to the occupation, 92% of academia and researchers had awareness and positive perception towards highly processed food. The taste and convenience (53%) were the major reasons for consuming highly processed foods. Mostly consumed highly processed foods were ice cream, instant noodles and soft drinks. More than half of the respondents (57%) had selected retail shops as shopping place. Online buying choice had a small influence on the positive perception. Results clearly revealed that young generation and academia have better awareness and positive perception on highly processed food products.

Keywords: Consumer awareness, Convenience, Highly-processed food, Perception

Development of Roasted Sesame (*Sesamum indicum*) Incorporated Chicken Nugget

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Chicken nugget is an encrusted meat product. Roasted sesame seeds possess antioxidant and anticancer properties. Therefore, present study was to develop a value added chicken nugget by incorporating roasted sesame seeds and elucidate its quality parameters. Nuggets were prepared according to the commercial guidelines by incorporating roasted sesame and without sesame (control). Preliminary trials were conducted to determine the suitable levels of sesame. A sensory evaluation was conducted using a 7-point hedonic scale and 30 untrained panelists to select two best nugget samples with sesame. The control and two selected samples were tested for proximate composition, pH, colour, water holding capacity, cooking loss, microbial quality and TBARS value to evaluate lipid oxidation over a one-month storage period. Based on the results, 5, 10 and 15% (w/w) treatments were initially selected and nuggets with 5 and 10% (w/w) roasted sesame were chosen as the best treatments ($p<0.05$) during the sensory evaluation. Results further revealed that nuggets with 10% roasted sesame had the highest fat (8.84%), protein (14.24%) and ash (3.15%) contents compared to other treatments ($p<0.05$). At the initial stage of the storage, results showed that nuggets with 5% sesame had the highest pH (6.68) value and lowest cooking loss value (1.46%) while 10% sesame had the highest water holding capacity (97.28%). pH values and water holding capacity of chicken nuggets were decreased while cooking loss values were increased ($p<0.05$) in sesame added treatments. Furthermore, TBARS and total plate count values were increased in sesame added treatments with storage but, within the permitted levels. *Salmonella* and *Escherichia coli* were absent in all samples. Therefore, roasted sesame seeds can be used to prepare nuggets with high nutritional and sensory properties.

Keywords: Chicken nuggets, Roasted sesame, Antioxidant, Microbial, Sensory

Effect of Marination with Fruit Juices and Vacuum Packaging on Quality Characteristics of Chicken Wings

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Antioxidants present in fruits and vegetables have a potential to reduce disease risk, and increase the shelf life of food products by reducing lipid oxidation. The effect of marination with fruit juices rich in antioxidants [pineapple juice (PJ), mango juice (MJ) and June plum juice (JJ)] and vacuum packaging on sensory, physicochemical characteristics, and keeping quality of chicken wings stored under refrigerated condition were examined. Marinades were prepared with water (37%), fruit pulp (60%) and salt (3%). Chicken wings were marinated (1:1 w/w) and kept for 12 and 24 hrs separately. Raw chicken wings were taken as the control. Three best marination conditions were selected by a sensory evaluation. Selected samples and control were stored at 4^{o}C under vacuum and normal packaging methods. Marinade uptake, marinade loss, and proximate composition were evaluated. In addition, pH, water holding capacity (WHC), color, TBARS value, antioxidant activity (AOA) using DPPH assay and total phenolic content (TPC) using Folin Ciocalteu method were measured over the storage for 2 wks. Results showed that, chicken wings marinated with PJ-24 hr, MJ-24 hr and JJ-12 hr had the best sensory properties ($p<0.05$). Marinade uptake was high in MJ-24 hr sample and marinade loss was high in JJ-12 hr sample. MJ had the highest AOA (92.2%) and TPC (38.45 µg/mL) followed by PJ and JJ ($p<0.05$). Marinated samples had higher ash content. Control had the highest pH and PJ sample had the highest WHC. pH and WHC were slightly decreased in vacuum packed samples and drastically decreased in normal packed samples with storage ($p<0.05$). Meantime, vacuumed packed chicken wings with MJ had the lowest TBARS value and microbial count. TBARS and microbial count values of vacuum packed chicken wings with MJ were within the permitted limits at 2 wk storage. Therefore, it can be concluded that marination with MJ followed by vacuum packaging increased meat quality traits and shelf life of chicken wings.

Keywords: Antioxidants, Shelf life, Lipid oxidation, Marinade, Meat quality traits

Development of Cost Effective Jerky from Spent Hen Meat and Maize (*Zea mays*) Flour

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Jerky is a favorite, semi-dried and shelf stable meat based snack food in the world with high nutritive value. This study was conducted to develop jerky from spent hen meat by addition of maize flour (MF) for reducing the cost of production. Ground meat was mixed with ingredients, reformed into strips, and dried in an oven (85°C, 1½ h). Six treatments of spent hen meat jerky (SHJ) were prepared by changing the salt-pepper combination with and without bee honey. A sensory evaluation was conducted to select the best recipe and it was taken as the control. Four treatments were then prepared by replacing spent hen meat with MF at 3%, 6%, 9%, and 12% (w/w). Two best recipes were then selected from a sensory evaluation and they were vacuum packed and stored under the room temperature. The control sample and the two selected samples were tested for drying yield, meat quality traits, TBARS value, and microbial quality. First sensory evaluation showed that the highest overall acceptability was recorded for 1.5% (w/w) salt and 0.5% (w/w) black pepper combination without bee honey ($p<0.05$). According to the second sensory evaluation, SHJ with 3% and 6% (w/w) MF showed better overall acceptability ($p<0.05$). The drying yields of three treatments were comparable ($p>0.05$). The initial lightness and yellowness values of three SHJ were significantly different ($p<0.05$) and the redness value was comparable ($p>0.05$). SHJ with MF showed a higher ash content and lower pH, moisture, crude fat and crude protein contents than the control sample ($p<0.05$). SHJ with 6% (w/w) MF had the lowest fat content with the highest ash content ($p<0.05$). TBARS values for all treatments increased with 28-day storage period, but within the accepted limits; SHJ with MF showed lower TBARS values than the control sample ($p<0.05$). *Salmonella* and *Escherichia coli* were not detected in any sample. SHJ with 6% (w/w) MF had the lowest cost of production. These results suggested that, a cost effective jerky with better sensory and keeping qualities can be produced using spent hen meat with 6% (w/w) MF.

Keywords: Semi-dried, Keeping qualities, Sensory, TBARS

Identification of Possible Microbial Contamination Points in Bolla Fish (*Selar crumenophthalmus)* During Storage and Transportation from Kudawella Fish Harbour to Badulla Fish Market

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Improper storage and transportation conditions account for the quality deterioration of fish as it begins to spoil as soon as fish die. Spoiled fish may cause infections to the consumers. Objective of this study was to identify possible microbial contamination points in Bolla fish (*Selar crumenophthalmus)* during storage and transportation from Kudawella fish harbour to Badulla fish market. Randomly collected fish samples from three control points (before transportation, before unloading and after unloading) including ice samples with three replicates have been examined for the enumeration of total aerobic bacteria, *Salmonella* and *Escherichia coli.* Before transportation, the highest total aerobic bacteria count (18.03±0.03 log CFU g^{-1}) was observed in the fish gill samples and the lowest count was observed in fish muscle samples (17.93±0.02 log CFU g^{-1}). Total aerobic bacteria count was increased during first 6 hours after unloading, in Badulla market and after 12 hours bacterial count of fish gill and muscle samples were 18.56±0.01 log CFU g^{-1} and 18.49±0.01 log CFU g^{-1} respectively. Initial total aerobic bacteria count of skin swab samples was 18.07±0.01 log CFU g^{-1} and the count increased at the fish market during last 12 hours to 18.58±0.01 log CFU g^{-1}. All fish gill and skin swab samples collected from the market after 6 and 12 hour intervals were positive for both *E. coli* and *Salmonella* and fish muscle samples were positive only for *E. coli*. Ice samples collected at Kudawella fish harbour and Badulla fish market were positive for *E. coli*. Control point examination and presence of *E. coli* revealed that fish arrived to the fishery harbour as primary contamination. Also storage conditions of ice had positive effects on microbiological quality. In conclusion, there is a requirement to initiate sufficient sanitary applications to minimize cross contaminations in fish before reaching to consumer in both fishery harbour and Badulla fish market.

Keywords: Sanitary applications, Total aerobic bacteria, *Salmonella, Escherichia coli*

Smart Food Safety Management Framework for Small Scale Restaurants

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Food safety inspection is a crucial factor in small scale restaurants, to prevent food borne illnesses among the consumers. HACCP is the international tool to manage food safety effectively which can be used as a unique protocol to assure the food safety in any food company. However due to the limited time as a local public health inspector, food safety is a minor concerned subject in their field of working. Objective of this study is to enhance the existing Sri Lankan food inspection process to Badulla area through a developed risk-based food inspection system, which analyze, diagnose and implement main principles of food safety. Interviews with health professionals and pilot survey for small scale restaurants (30) were conducted to understand the existing food inspection programme. Based on that pilot survey, among the targeted group of food handlers most were lack of knowledge on food safety and sanitation. Hence, assessment model based on HACCP for food safety inspection in small scale restaurants was developed. In order to facilitate the end-users to use this developed model, an Android food safety application which consists of optimized user interfaces and offline database was developed. Prototypical development was achieved the user satisfaction in the field level due to its effectiveness and accessibility. As a result, it assures the food safety in small scale restaurants and has potential to improve the food safety practices in food services in the areas covered by the national hygienic and sanitary regulations. Furthermore, "big data" collection through this mobile application can be used for further data analysis, which creates multiple research opportunities.

Keywords: Food safety inspection, Android food safety application, HACCP

Identification of the Critical Control Points (CCPs) of a Commercially Established Pasteurized Milk Factory in Colombo

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HACCP is a systematic method of identifying, evaluating and controlling all possible hazards associated with a food chain. Implementation of HACCP system has become a necessity for dairy processors to assure the safety and quality of their products. This study was designed to identify CCPs in pasteurized vanilla milk processing line in a commercially established pasteurized milk plant. Preliminary study was carried out to familiarize with the production process while identifying the sample collecting points as raw milk receiving, mixing tank, filling unit and storage. Samples were collected from raw ingredients receiving to the final product. Collected samples were analyzed for physical, chemical and biological hazards. To determine biological hazards, total plate count (TPC), Coliform and yeast and mould tests were done. Adulteration tests for chemical hazards and visual observation for physical hazards were done. According to analysis, physical contaminants were present in raw milk samples. However, no chemical contaminants were detected. Microbiological hazard analysis revealed that TPC and coliform count were high in raw milk samples from bowser. TPC counts of raw milk samples from different milk collecting centers were 7.39±0.31, 7.43±0.27, 7.37±0.31, 7.01±0.20 and 7.40±0.26 log cfu ml^{-1} respectively while Coliform counts were 5.27±0.48, 5.18±0.55, 5.19±0.31, 5.32±0.37 and 5.23±0.42 log cfu ml^{-1}, respectively. All samples collected before pasteurization were positive for coliform. Post pasteurization contamination was observed in few batches while samples collected after pasteurization were positive for coliform. Post pasteurization contamination was not observed in the rest of the batches. Therefore, receiving of raw milk and the storage tanks of pasteurized milk were identified as the CCPs in the production process. Monitoring and controlling the identified CCPs are really essential to ensure the safety of the final product for the consumers.

Keywords: HACCP, Coliform, Pasteurization, Total plate count

Effect of Selected Wood Smoke on Physicochemical and Sensory Qualities of Tilapia *(Oreochromis niloticus*)

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Different preservation and processing techniques have been used to extend the shelf life of fish. Smoking is a technique that enhances the flavour, colour, texture and shelf life of fish. This study was conducted to identify specific smoking conditions for Tilapia (*Oreochromis niloticus*) while comparing the physicochemical and sensory qualities of Tilapia smoked using selected wood smokes. Tilapia fillets of same thickness were obtained and trials were conducted to identify the best brine concentration, temperature/time combination and wood material. The fillets were immersed in brine containing 2.5, 5.0, 7.5, 10.0 and 12.5% (w/v) NaCl for 1 hour. Then fillets were smoked with wood smoke under three different temperatures (50, 60 and 70°C) and three drying times (3, 4 and 5 hours) using a smoking oven. Based on the selected temperature/time combinations Tilapia were smoked using mahogany, cinnamon and their combination (1:1). Final products were vacuum packed and stored at 4°C for analysis. Quality changes in sensory attributes were tested with 30 untrained panelists. Microbial quality (*Salmonella*, *Escherichia coli* and Total Plate Count), TBARS, DPPH assay, pH and colour were detected during 21 days of chilled storage and proximate analysis was conducted. Fish brined in 10% (w/v) NaCl and smoked at 60°C for 4 hours using mahogany: cinnamon at 1:1 had the best sensory qualities ($p<0.05$). Microbial counts and lipid oxidation were within the permitted levels. During the chilled storage pH was changed from 6.63±0.09 to 6.70±0.08 ($p>0.05$). An increase in lightness (40.85±0.32 to 42.02±1.22) was observed whereas the redness (8.86±0.69 to 6.84±0.11) was decreased. In conclusion, immersing Tilapia fillets in brine containing 10% (w/v) NaCl followed by smoking at 60°C for 4 hours using mahogany: cinnamon at 1:1 can be considered as the best conditions to produce smoked Tilapia. However, further studies need to be done to compare the chemical changes occurred due to smoking.

Keywords: Tilapia, Wood smoke, Sensory qualities, Mahogany, Cinnamon

Evaluation of Antioxidative and Antimicrobial Activities of a Prawn Based Dipping Incorporated with Bioactive Fish Protein Hydrolysates from *Pterygoplichthys pardalis*

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Currently, the world is moving towards functional foods instead of traditional nutrient based foods. "PrawRy" is a value-added prawn and dairy based pre-cooked instant powdered food, which can be processed as a dipping, sauce, salad dressing or as a pudding. Due to its raw materials it is indisputably high in nutrition and its functionalities can be promoted by incorporating bioactive natural compounds. In the present study the "PrawRy dipping", which was made by cooking for 10 minutes with 1:2 ratio of powder mix (Prawn, milk, butter, garlic) and water, was enriched with pre-proved bioactive salt extracted internal organ (except GI tract) protein (protein: NaCl 10% (w/v) =1:4) hydrolysates of *Pterygoplichthys pardalis*. Fish protein hydrolysate (FPH) was prepared followed by incorporation of it in to "PrawRy dipping" at 0, 0.5, 1, 1.5, and 2% (w/w) and kept under refrigerated conditions. The bioactivities were then analyzed at 0, 2, 4 and 7 days of storage. Antioxidative properties were evaluated by TBARS, DPPH scavenging assays and Fe (II) chelating activity. Total plate count was detected to check the microbial growth in the final product. According to the results obtained, significant differences were obtained between treatments against non-treated product ($P<0.05$) in both DPPH scavenging and TBARS assays, Total plate count and in Fe (II) chelating activity assay. Further, significant differences were obtained between days against non-treated product ($P<0.05$) in TBARS assay, Total Plate Count, Fe (II) chelating activity assay while no such difference was demonstrated in DPPH scavenging assay (except in day 0). The highest antioxidative activity and resistance against microbial growth was demonstrated by 2% (w/w) FPH incorporated "PrawRy dipping". The study concluded that the "PrawRy dipping" can be enriched with antioxidative and antimicrobial properties by incorporating salt extracted 2% (w/w) protein hydrolysates of *P. pardalis* as a value-added functional food.

Keywords: DPPH, TBARS, Fish protein hydrolysates, Functional foods, Chelating

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Effect of Marinating Chicken Breast Meat with Coconut Vinegar on Lipid Oxidation During Storage

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Lipid oxidation results both desirable and undesirable compounds in meat. These undesirable compounds adversely affect on overall quality and consumer acceptability of meat. This research was conducted to find out the effect of coconut vinegar on the lipid oxidation of marinated chicken breast meat (MCBM) during storage and to evaluate the physicochemical properties of MCBM. Marination solution was prepared with water, spices and different levels of vinegar where control contained no vinegar, treatment 1, 2, 3 and 4 had vinegar: water ratio at 1:0, 1:1, 1:2 and 1:3, respectively. Chicken breast meat was marinated with above solutions at 4^{o}C for 24 hr. Cooked meat samples (internal core temperature of 75°C) from marinated treatments were then evaluated for sensory properties using a 7-point hedonic scale and 30 untrained panelists. Based on its results, the two best treatments were compared with the control in replicates for pH, color, texture, water holding capacity, cooking loss, uptake of marinade, proximate composition, TBARS value and microbial quality over a one-month storage period. Results showed that Treatment-3 and 4 had the best sensory properties according to the overall acceptability. Treatment-3 and 4 are comparable for pH and treatment 3 showed the highest lightness and yellowness values for day 0 when compared with the control ($p<0.05$). Ash and crude protein contents were not affected ($P>0.05$) by vinegar when subjected to marination. However, moisture content, crude fat content and marinade uptake were affected by the addition of vinegar ($P<0.05$). The pH value declined gradually until the second week and then increased slightly during the third and fourth weeks for each treatment. *Salmonella* and *Escherichia coli* were not detected in any sample during storage. Colony count (Control: 0.58×10^{10} -2.07×10^{10} CFU mL^{-1}, Treatment-4: 0.57×10^{10} - 1.9×10^{10} CFU mL^{-1}, Treatment-3: 0.41×10^{10} - 1.77×10^{10} CFU mL^{-1}) and TBARS values (Control: 0.173-0.831 MDA mg kg^{-1}, Treatment-4: 0.165-0.458 MDA mg kg^{-1}, Treatment-3: 0.161-0.408 MDA mg kg^{-1}) increased with the storage, but within the accepted limits. Based on the TBARS values coconut vinegar can be used to marinate chicken breast meat with the aim of reducing lipid oxidation.

Keywords: Meat quality, Vinegar, TBARS, Sensory

Development of a Ready to Eat Canned Fish Using Underutilized Fish with Different Filling Materials

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Fishes are one the most important nutrient sources for humans. Nowadays the demand for ready to eat food is increasing. Present study was to develop a ready to eat canned fish by using underutilized fish. Two fish species, Frigate tuna and Rainbow runner were used and preliminary trials were conducted to find out the best spices level (chili powder, pepper, coriander, garlic, turmeric, cinnamon, ginger, brindle berry cream, cardamom, curry leaves, pandan leaves) and filling solutions (tomato sauce, soy sauce, soybean oil and water) followed by sterilization at 121ºC for different times (50, 65, 70, 75 minutes) using 30 untrained panelists. Colour, texture, aroma, juiciness, mouth feel, overall taste and overall acceptance tested were analyzed by using the 9 point hedonic scale. Best combination of species and filling solutions were subjected for keeping quality analysis by checking pH, lipid oxidation (TBARS and DPPH) and microbial count (TPC, E. coli and Salmonella). According to the sensory data, soy sauce and tomato sauce were selected as the best filling solutions for Frigate tuna and Rainbow runner ($p<0.05$). Rainbow runner was better in all sensory attributes in tomato sauce and soy sauce compared to the rest ($p<0.05$). Sterilization for 65 minutes at 121ºC was selected as the best sterilization condition in comparing organoleptic properties ($p<0.05$). Canned fish produced by Rainbow runner with tomato sauce and soy sauce were selected for keeping quality analysis. Final products were free from *E. coli* and *Salmonella*. pH of the soy sauce and tomato sauce range from 5.65±0.19 to 5.75±0.01 and 5.59±0.10 to 5.64±0.11, respectively during storage. Lipid oxidation and TPC were within the acceptable levels during the storage period for 30 days at room temperature. Proximate analysis confirmed that the product is rich in protein. As the conclusion, Rainbow runner fish can be used as one of the best underutilized fish species to produce ready to eat canned products.

Keywords: Keeping quality, Proximate analysis, Frigate tuna, Rainbow runner

Effect of Dryer Conditions on Quality of Cinnamon (*Cinnamomum zeylanicum* Blume) Quills Before Packaging

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Cinnamon is one of the major spices important in export economy. Improper drying of the cinnamon quills may cause to microbial and insect infestations on packed cinnamon quills and it causes quality deterioration of final product. This study was conducted to identify most suitable dryer condition to maintain the export quality of the cinnamon quills before packaging. The prepared cinnamon quills were dried at different temperatures (35, 40, 45 and 50ºC) for different time periods (2, 3, 4, 5 and 6 hours) in dryer. The experiment was conducted as triplicate using 21 treatments with control (shade dried under room temperature, 24 hours). Moisture percentage (Dean and Stark method), oil yield (Clevenger arm method), water activity, microbial count (CFU), pest count per 100 g, cinnamaldehyde content (GCMS) and color (Munsell colour chart) of the cinnamon quills were measured before and after drying. Mean values of moisture contents under different treatments were less than 15% (Standard value).Mean values of oil contents under (35, 40 and 45ºC) and (2, 3, and 4 hours) were greater than 1% but values ($P > 0.05$).Water activity of all treatments were less than 0.75 and 35ºC, 2 hours treatment was significantly differed from all other treatments except 35ºC, 3 hours ($P < 0.05$).Treatments under 35ºC, 3 hours and 35ºC, 2 hours conditions were resulted microbial growth but other treatments were not ($P < 0.05$). Zero pest count was in sample dried at 35ºC for 6 hours and temperatures higher than 35 ºC ($P < 0.05$). Mean values of cinnamaldehyde content were greater than 50% in all treatments. Colour did not vary changed significantly among different treatments. Temperature in between 40 – 45ºC for 2, 3, 4 hours were not adversely affected to the quality of cinnamon quills based on oil content, insect count and microbial count. Considering high oil content, microbial and pest count it can conclude that 40ºC, 3 hours is the optimum dryer condition to keep the export quality.

Keywords: Quality, Dryer condition, Microbial count, Oil content, Colour

Determine the Effect of Functional Properties on Chicken Patty Incorporated with Salt Extracted Bioactive Compounds from *Pterygoplichthys pardalis* (Scavenger Fish)

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Pterygoplichthys pardalis is a tropical and invasive fresh water fish. Based on literature, the extracted compounds from this fish consist of anti-oxidative, antimicrobial and Fe^{2+} chelating activities. Hence, the objective of this study was to determine the effect of these functional properties on chicken patty, incorporated with salt extracted bioactive compounds from *Pterygoplichthys pardalis*. Female fish were collected from a local reservoir and slaughtered in the field. Gonads (excluding GI tract and mucus) were separated within 3 hours and stored at 4°C. Separated parts were followed for extraction of proteins with distilled water (1:4) and then 10% (w/v) NaCl solution (1:4) and lyophilized. Extracted protein samples were incorporated to the preparation of chicken patty (Chicken meat, Salt, Spices) with 0, 0.5, 1, 1.5 and 2% (w/w) levels. Then TBARS assay, DPPH assay, Fe^{2+} chelating activity and Total plate count were done for the product for Day 0, 2, 4, 7 and 14. According to TBARS and DPPH assay 2% (w/v) incorporation level gave the highest antioxidant activity and Fe^{2+} chelating activity ($p<0.05$). Microbial counts of meat patty with 2% (w/v) incorporation level was suitable for 7 days compared with the control ($p<0.05$). As conclusion, 2% (w/v) incorporation level of salt extraction from *P. pardalis* can be used as a natural antioxidant, antimicrobial and metal chelating agent in chicken patty. However further studies needed to check for the maximum level of incorporation.

Keywords: TBARS, Bioactive compounds, Meat patty, Total plate count

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Effect of Different Coagulants and Fat Content on the Quality of Ricotta Cheese

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Whey is a major by-product in cheese processing which is considered as a rich source of whey protein and lactose. In Sri Lanka whey is largely discarded without taking any valuable usage. Ricotta is a low fat and versatile cheese, popular in many countries which can be produced using w hey. This study was conducted to compare the chemical and sensory properties of ricotta cheese, developed using whey enriched with full cream milk (fat 3.5%) or skim milk (fat <0.1%) with acetic acid or citric acid coagulants. Whey was freshly collected from a cheddar cheese processing plant and processed in to ricotta cheese within the same day. Fresh whey was heated without agitation and milk and coagulant were added at the temperature of 71^{o}C and 85^{o}C respectively. Curd was collected in a cheese cloth, drained for 1h, packed and stored at 4^{o}C. Four ricotta cheese batches were prepared, namely full cream milk-acetic acid (FMAA), full cream milk-citric acid (FMCA), skim milk-acetic acid (SMAA), and skim milk citric-acid (SMCA). Prepared ricotta cheese were evaluated for sensory, physicochemical (pH, texture, color, titratable acidity, moisture, total solid, fat, ash, protein and carbohydrate) and microbiological properties. Sensory evaluation data were analyzed by Friedman non-parametric test. FMAA ricotta cheese gained significantly higher ($p<0.05$) overall acceptability among all cheese types. Addition of citric acid gave low yield to ricotta cheese (22%-FMCA and 20%-SMCA) as compared to acetic acid (25%-FMAA and 23%-SMAA). Significantly lower fat (2.40%), ash (32.68%) and moisture content (62.92%) were obtained in SMAA ricotta cheese ($p<0.05$). In conclusion, whey can be successfully converted into a value added product using full cream milk and acetic acid. This could be a good solution for the wastage and high biological oxygen demand (BOD) in environment pollution.

Keywords: Acetic acid, Coagulation, Fat, Ricotta cheese, Skimmed milk

Study of Accumulation of Polycyclic Aromatic Hydrocarbons (PAHs) in Smoked Fish (*Thunnus albacares*) Under Different Storage Conditions

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Fish smoking is the most extensively used simplest preservation technique. Although, accumulation of carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) from wood burning is a major problem associated with the smoked fish. Hence, this research was focused to study the penetration of PAHs in to center of the smoked fish (*Thunnus albacares*) and effect of accumulated PAHs content with the time under different storage conditions. Fish chunks having equal thickness were smoked using smoke of coconut husk and stored under refrigerated (4^{o}C) and frozen (-18^{o}C) conditions. PAHs content of surface and center part of stored smoked fish chunks were analyzed at predetermined time intervals by Infinity Quaternary Gradient HPLC system with FLD and UV detectors. Moisture content, water activity, pH, texture, and color of smoked fish samples were also analyzed. PAHs content (Anthracene) of the surface of the smoked fish at the beginning of storage was 190.39 µg/kg and that was declined during both refrigerated (after 6 day 130.09 µg/kg) and frozen storage (after 15 day 106.19 µg/kg). But PAHs content (Anthracene) of the center of the smoked fish at the beginning of storage was 0.00 µg/kg and that was increased during both refrigerated (after 6 day 19.88 µg/kg) and frozen storage (after 15 day 45.47 µg/kg). There were no significant changes in the moisture content (68.49±0.5%) water activity (0.967±0.007), pH (6.04±0.21) and firmness (0.909±0.162 kg) of the smoked fish during the storage ($p>0.05$). Therefore, results revealed that PAHs penetrate in to the center part of the smoked fish during the storage.

Keywords: Polycyclic aromatic hydrocarbons, Smoking, Storage conditions, Physiochemical parameters

Variation of Mesophilic and Thermophilic Spore Counts in UHT Processing of Full Cream Milk

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Demand for the UHT treated milk has been largely increased in the Sri Lankan market in the recent past. Quality deterioration of UHT products will degrade the brand reputation and make health risks for the consumers. Thus, the present study was focused to determine mesophilic (MP) and thermophilic (TP) spore count variation pattern in UHT processing of full cream milk and to identify contamination points in the processing line. Seven control points in the processing line were identified; (milk receiving bowsers, milk line-just after thermizing, silos-6-12 h after storage, processing line-just after pasteurizing the mix, mix storage tanks (MST)-1h after pasteurized mix stored, balance tank-before UHT treatment, final product-soon after UHT treatment) and 16 milk samples from each point were collected in triplicates. Spore counts were evaluated by heating to 100^{o}C for 10 minutes and subsequent culturing on plate count agar followed by incubation at 55^{o}C for 2 days for TP spore counts and at 35^{o}C for MP spore counts. Vegetative cell counts and spore counts were evaluated during 4 months of ambient temperature storage at 30 days interval. Swab samples and clean-in-place final rinse samples were collected from 7 control points and analyzed for *Coliforms* and total plate count. Significantly higher MP and TP spore counts were observed as $9.00\pm8.79 \times 10^2$ cfu/mL and $1.09\pm1.01 \times 10^2$ cfu/mL, respectively in MST after pasteurization. This may be due to the heat stress at the pasteurization process which may have induced the spore formation by bacteria. Significantly lower MP and TP counts were observed in the final product (1.70 ± 5.30 cfu/mL and $3.34\pm17.9 \times 10^2$ cfu/mL, respectively). In conclusion, there is a requirement to initiate good agricultural practices to reduce bacterial load coming from the farm level and to initiate good manufacturing practices to reduce the cross contamination during processing.

Keywords: Mesophilic spores, Thermophilic spores, UHT processing

Development of Fish Balls Using Catla Fish (*Catla catla*): Exploration the Potential of Better Utilization of Freshwater Food Fish in Sri Lanka

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Catla fish is the one of mostly cultivated, freshwater food fish in aquaculture sector. Present study was aimed to enhance Carp fish production by developing a value added fish ball products from Catla using appropriate processing technologies. Catla fish were collected from Ulhitiya reservoir. Three different treatments of fish meat:ice water ratios (w/v) as: 50%:37% (treatment1), 70%:17% (treatment2) and 85%:2% (treatment3) were used for fish ball processing after the preliminary trials. Organoleptic evaluation was conducted to determine color, texture, aroma, mouth feel, taste and overall acceptance of products using 30 untrained panelists. pH, color, and TBARS values of all final products at -20°C freezing condition were measured weekly. The proximate compositions of fish ball products were analyzed following standard protocols. Based on the results, highest scores for aroma, taste and overall acceptance were recorded for treatment 2 (fish meat: ice water-70%:17%). Ash content of treatment 1, 2 and 3 were 4.06±0.4%, 4.27±0.92% and 4.00±0.82% respectively with no significant difference ($P>0.05$). However, moisture and lipid contents had significant difference ($P<0.05$) among the treatments, while the highest lipid content was recorded in treatment1 (6.96±0.60%) and the lowest moisture content was recorded in treatment2 (70.15±2.43%). Protein content of Catla fish ball products varied from 14.00 to 15.00%. TBARS and pH of all treatments were at the range of 6.41-6.51 and 0.36-0.90 mg MDA/kg respectively which were within acceptable levels for consumption during storage. L*, a* and b*values of final products gradually decreased during storage period, but without significant ($P>0.05$) variation during storage period. In conclusion, Catla is a suitable alternative source for production of high quality, consumer preferred fish balls.

Keywords: Food fish, Nutritional quality, Catla, Consumer, Physico-chemical parameters

Development of a Coconut Milk Beverage Incorporated with Cinnamon and Ginger

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There is a great potential for commercialization of spiced natural beverages, dairy free and healthy drinks from coconut milk in both domestic and the international market front. This study was focused to develop and assess the nutrient content and physicochemical properties (pH, fat%, moisture%, brix, free fatty acid [FFA] and titratable acidity [TA] as citric acid) of a spiced coconut milk beverage. Both spices were added at 0.2% (w/v). Five treatments were prepared by incorporating Cinnamon powder: Ginger powder at the rate of 25%:75% (T1), 40%:60% (T2), 50%:50% (T3), 60%:40% (T4) and 75%:25% (T5) (w/w). Sensory evaluation of the product was tested using 9-point Hedonic scale with 30 untrained panellists and the results were analysed using Friedman test. The highest overall acceptability was recorded by T5, contained 75% cinnamon and 25% ginger. The T5 was further assessed for the changes of physicochemical properties for one month at the room temperature, and data obtained were analysed using one-way ANOVA. Microbial quality (aerobic plate count, yeast and mold, *E. coli*, coliform and salmonella) was tested for one-month period. According to the results of nutrient analysis, the selected product is free from cholesterol and consists with 6.7% carbohydrate, 0.3% protein and 2.1g of dietary fibre, and 64 kcal per 100g of beverage. The selected coconut milk beverage (T5) consists with 4.60±0.01 pH, 10.50±0.00 °Brix value, 1.70±0.01% fat, 0.225±0.000% FFA, 0.005±0.000% TA and 88.52±0.01% moisture. During storage, no significant difference ($P>0.05$) were observed in pH, brix, FFA and moisture. However, fat% and TA of the product showed a significant difference ($P < 0.05$) over the storage. There was no observed microbial growth in the product during storage. In conclusion, the best cinnamon: ginger ratio to develop nutritious spiced coconut milk beverage is 75%:25%.

Keywords: Spiced coconut milk beverage, Cinnamon, Ginger, Value addition

Determination of Total Polyphenol Content of Ceylon Green Tea

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Green Tea is made from the leaves of the *Camellia sinensis* and is used most popularly as a beverage all over the world. Leaves of green tea are rich in bioactive compounds, particularly phenolic compounds which are closely associated with the sensory properties and quality of tea brew. Epicatechin (EC), epicatechin-3-gallate (ECG), epigallocatechin (EGC) and epigallocatechin-3-gallate (EGCG) are the main active ingredients of green tea and which are the major polyphenols of green tea. Ceylon green tea industry is young and growing rapidly. Green tea is produced by manufactures in mid and high elevation in Sri Lanka using steaming and pan firing methods. During the green tea manufacturing, high temperature is applied for the enzyme deactivation. Therefore, green tea is called as unfermented tea which has higher polyphenol content than black tea. The objective of the study was to determine the total polyphenol content of Ceylon green tea depending on processing method, elevations (High and Medium) and sub elevation levels in selected elevations (Uva and Western). Total polyphenol content was determined according to the International Organization for Standardization method (ISO) 14502-1:2005. The analysis showed that there is significant ($P<0.05$) relationship between tea making method and elevation as well as the elevation and sub elevation. According to the results, green tea manufactured in high elevation by pan firing method contained the highest level of polyphenols (25.4%) whereas the green tea manufactured in medium elevation by steaming method contained the lowest amount of polyphenols (21.2%) than others. Uva, high elevation green tea contained the highest level of polyphenols (24.5%) whereas the Uva, medium elevation green tea contained the lowest amount of polyphenols (21.3%) than others in Sri Lanka.

Keywords: Green tea, Polyphenol content, Tea making method, Elevation, Sub elevation

Analysis of Chemical Properties and α-Amylase Inhibition of Selected Medicinal Plants for the Development of Herbal Tea

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Herbal medicines are widely used around the world because of their safety, health benefits and very less or no side effects. Further, it's known that, herbs have high content of bioactive compounds which are produced in plants through secondary metabolism. From the ancient time, the natural remedies in Siddha medicine are used to cure the non-contagious diseases such as cancer, diabetes, asthma etc. However, young generation is reluctant towards herbal remedies as there are not much scientific evidences to prove their benefits. The present study attempted to identify the chemical properties and α-amylase inhibition of selected herbs namely *Solanum trilobatum, Ocimum tenuiflorum, Cardiospermum halicacabum, Acalypha indica and Plectranthus amboinicus* and intents to develop herbal tea. Selected herbs were dried in an oven for 12 hours at 50℃ and infusions were prepared by boiling 1-5 g of dried sample in 100 ml of distilled water. Infusions were tested for their antioxidant properties using DPPH (1, 1-diphenyl-2-picrylhydrazyl) Radical Scavenging Assay and α- amylase enzyme inhibition using di nitro salicylic acid method and finally IC_{50} value was also determined. The highest level of antioxidant properties has been observed in *Cardiospermum halicacabum* (7.7 mg mL^{-1}) while it's also having maximum α-amylase inhibition activity (45.5 mg mL^{-1}). Hence, sensory evaluation was done to select the best sample for consumption and it was subjected to the chemical analysis. The phytochemical analysis confirmed that all these leaf infusions contain in between the range of Anthocyanin (0.13-8.31 mg L^{-1}), Polyphenol (115.23-236.64 mg L^{-1}), free sugar (24.67-236.64 mg L^{-1}). Accordingly, there is a potential to develop the herbal tea by using these five herbs.

Keywords: Alpha amylase inhibition, Anti-oxidant, Free sugar, Phytochemicals, Siddha medicine

Effectiveness of Trisodium Phosphate, Lactic Acid and Acetic Acid on Microbial Count of Chicken Cold Cuts (Chicken Salami and Chicken Roll)

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Limited shelf life of meat products due to microbial spoilage is a major problem in meat industry as meat is a good source for growth of microorganisms. Therefore, preservation is essential. Thus, the present study was focused to determine the effect of acetic acid, lactic acid and trisodium phosphate on microbial quality of chicken cold cuts (chicken salami and chicken roll). Samples were randomly collected during the chilling step and treated as groups by immersion in lactic acid (2, 3, 4%), acetic acid (2, 2.5, 3%), trisodium phosphate (8, 10, 12%) for 20 seconds. Samples without any treatment served as the control. All treatments were vaccum packed and stored under chilled condition. Treatments were evaluated for colony forming units (CFU), yeast and molds and pH in 10^{th}, 20^{th}, 30^{th} and 40^{th} day of storage. Based on CFU counts for chicken salami samples on 40^{th} day, acetic acid 2, 2.5, 3% treated samples showed 1.55×10^5 CFU/g, 1.31×10^5 CFU/g, 1.16×10^5 CFU/g, lactic acid 2, 3, 4% treated samples showed 1.56×10^5CFU/g, 1.43×10^5 CFU/g, 9.60×10^4 CFU/g, trisodium phosphate 8, 10, 12% treated samples showed 1.62×10^5 CFU/g, 1.61×10^5 CFU/g, 1.49×10^5 CFU/g and control sample showed 3.45×10^5CFU/g while acetic acid 2, 2.5, 3% treated chicken roll samples showed 1.65×10^5 CFU/g, 1.44×10^5 CFU/g, 1.17×10^5 CFU/g, lactic acid 2, 3, 4% treated samples showed 1.58×10^5 CFU/g, 1.43×10^5 CFU/g, 1.01×10^5 CFU/g, trisodium phosphate 8, 10, 12% treated samples showed 1.69×10^5 CFU/g, 1.64×10^5 CFU/g, 1.61×10^5 CFU/g and control sample showed 3.33×10^5 CFU/g respectively. Therefore, CFU counts for both products showed numerical reduction than the control samples and similar trend was observed in yeast and mold on 40^{th} day of storage. During storage, the pH of samples treated with acid were declined and the pH of samples treated with base were increased. Hence, the acetic acid, lactic acid and trisodium phosphate treatments have a potential to reduce the microbial count in chicken cold cuts.

Keywords: Chicken roll, Chicken salami, Microbial quality

Effect of Microbiological and Chemical Factors on Flavour of Spray Dried Full Cream Milk Powder

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Full cream milk powder is susceptible to flavour changes which limit its shelf life and consumer acceptability. Natural flavour of full cream milk powder can be degraded during production process and storage as a result of lipid oxidation and lipolysis induced by extracellular microbial enzymes. The aim of this study was to determine chemical and microbiological factors which influence the flavour of milk powder processed in two spray drying plants (Plant 1 and Plant 2). Twelve samples were collected from spray drying milk powder plants at three different time periods for four weeks (0, 7, 14, 21 day) in replicates. Lipid oxidation value (TBARS), free fatty acid content, peroxide value, yeast and mold count and vegetative microbial count of milk powder samples were evaluated using standard protocols. Thermophillic spore counts were evaluated by heating milk powder samples at 106°C for 30 min subsequent plating on plate count agar and incubating at 55°C for 48 h. Results of the study showed that TBARS value of samples from Plant 2 were higher than those of Plant 1 ($p<0.05$). In addition, free fatty acids content of milk powder samples from Plant 1 were lower than those from the Plant 2 and vegetative cell counts were significantly higher in full cream milk powder samples of Plant 1 compared to those of Plant 2 ($p<0.05$). Finally, it can be concluded that chemical factors including lipid oxidation and lipolysis induced by heat resistant microorganisms can affect the final flavour of spray dried full cream milk powder.

Keywords: Lipid oxidation, Free fatty acid, Lipolysis, Vegetative microbial count

Developing a Computer Software for Blending Black Tea

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Tea is manufactured from the young shoot of the tea plant (*Camellia sinensis* L.). Black tea is manufactured by subjecting the fresh tea leaf in to withering, rolling, fermenting and drying. Quality of black tea varies with variety of tea, manufacturing process, region, climatic conditions etc. Price of black tea varies with its quality. Buyers of the bulk tea blend tea from various manufacturers to make the quality and price of the tea in the retail market fairly consistent. Quantity of tea from various manufacturers that should be added to make a particular blend is decided arbitrary by tea tasters based on the sensory evaluation of samples of tea from individual manufactures. Initially, a trial blend is prepared and check whether the intended properties are met. This process is time consuming and laborious. Therefore, user friendly computer software was developed using JAVA language to make the tea blending process convenient and accurate. Programing was done using matrix algorithm. Price and rank data (five point hedonic) on sensory evaluation (color brightness, strength and aroma) of initial tea samples and desired price and rank data (five point hedonic) on desired sensory properties of the intended blend are the input variables. The developed software is to be tested in commercial blending process and further fine-tuned.

Keywords: Black tea, Blending, Computer software, JAVA, Matrix algorithm

Development of Coconut (*Cocos nucifera*) Water Jelly

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Coconut water is a natural nutritious liquid available inside the coconut fruit. Coconut water separated during the manufacturing of coconut kernel products processes as a by-product. Thus, the present study aims towards the development of a jelly using coconut water as main ingredient with the purpose of utilizing this by-product. Gelatin [1.57% (w/w)] and citric acid [0.078% (w/w)] were used as minor ingredients. Three levels of sugar [20, 30, and 40% (w/w)] were used while all other ingredients kept constant. The prepared product was packaged in polypropylene cups and stored under refrigerated conditions (4˚C). Appearance, aroma, texture, taste and overall acceptability were evaluated as sensory attributes using 9-point hedonic scale with 30 untrained panelists. Sensory data were analyzed using Friedman test with 95% level of significance by Minitab 16.1. The best jelly sample selected based on the results of sensory evaluation was tested for physicochemical properties such as pH, titratable acidity and total soluble solids (TSS). Aerobic plate count, yeast and mold, coliform and *Escherichia coli* tests were carried out to evaluate the shelf life. The pH, TSS and titratable acidity of the final product were 4.70±0.00, 50±0.00 and 0.04±0.00%, respectively. There was no significant difference in pH ($p>0.05$) and TSS ($p>0.05$) during the three weeks of storage period. However, the titratable acidity was significantly increase ($p<0.05$) during the storage period. Jelly sample prepared using the 20% (w/w) sugar received the highest overall acceptability. Based on the microbial analysis, the product was safe for consumption up to 3 weeks period. In conclusion, coconut water, a by-product of coconut can be effectively utilized to develop jelly and further studies are needed to identify the proper storage condition.

Keywords: Coconut water, Jelly, Sensory, Shelf life, Sugar

Identification of Solid Losing Points and Quantification of Total Solid Loss in Coconut Milk Powder Production

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Coconut milk powder is a water dispersible solid obtained by drying an aqueous extract of coconut (*Cocos nucifera*) kernel. It is a substitute to coconut milk which makes cooking convenient. A Sri Lankan coconut milk powder production plant equipped with spray drying technique is experiencing a solid loss problem during its production process. This case study was carried out to identify the solid losing points and to quantify solid loss during the process. Solid contents in raw materials, intermediates and final product were measured and solid loss from each step was calculated. Daily waste generation was recorded. Accuracy of tote bin scale set point and flow meters was investigated by checking the deviation between set point and actual quantity in several trials. The human errors in total solid analysis, rework bagging and plunging process were identified by monitoring working behavior of operators. Accuracy of total solid, fat and moisture analyzers was determined by analyzing previous calibration data. Sample weights were recorded during a month and sampling loss was estimated. Average total solid loss quantified through this study was 0.52%. In conclusion, waste generation, sampling loss and human errors were identified as the major causes for total solid loss. Standardizing the unloading process using flushing water in a predetermined constant temperature and pressure for a constant time, reducing waste generation and sustaining through attitude development, displaying posters, training on correct methods of rework bagging, plunging and total solid analyzing, standardizing the required sample quantity, defining the sampling points and using instrument calibration data tracking tools can be recommended to reduce solid loss in commercial scale coconut milk powder production processes.

Keywords: Coconut milk powder, Spray drying, Total solid loss

Development of Savory Nutrient Bar

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This study was carried out to develop a balanced, savory nutrient bar with readily available commodities in Sri Lankan market in every season. The savory nutrient bar was specifically developed for the local market which is currently saturated solely by sweet nutrient bars. Rice flour, chickpea flour, soy flour, puffed rice, pumpkin powder, moringa leafs powder, dehydrated guava coarse articles, onion powder, garlic powder and a non-sweet binding agent were used as the common ingredients. Three nutrient bars were developed separately by incorporating dehydrated pineapple coarse particles and tomato powder (A), mushroom powder and tomato powder (B) and mushroom powder (C) with the common ingredients. The mixture of dry food ingredients were combined with the binder at 3:1 (w/w).A specific compressing machine and mould were developed to produce the pieces uniformly and consistently. Prepared nutrient bars were packed in the triple laminated pouches and kept under ambient conditions. Sensory acceptability was evaluated using 5-point hedonic scale with the 23 trained panelists and the results were statistically evaluated by Friedman test using Minitab 16.1. Sample B and C were rejected based on the sensory evaluation results. Sample A was selected from the sensory evaluation and analysis of the sample A revealed that it contained 12.2±0.60% moisture, 4.14±0.05% ash, 2.12±0.44% acid insoluble ash, 12.35±0.23% crude protein, 9.78 ±0.13% crude fat, 8.8±0.12% crude fiber, 52.8±0.94% carbohydrate and 0.7±0.02% of water activity. The product is microbiologically safe for consumption up to 7 days.

Keywords: Savory nutrient bar, Non-sweet binder, Microbial, Tomato powder, Dehydrated pineapple

The Role of Food Quality and Safety Certificates of Biscuits on Purchasing Behavior of Consumers in Colombo District

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Food quality and safety certification is a third-party authentication which gives an assurance to its customer that the products, processes or systems meet its accredited food safety and quality standards. But customers would have diverse perspectives regarding the product quality whether these certifications displayed in the products to convince the customer. Therefore, this research was focused to identify the role of food quality and safety certificates on consumer purchasing behavior for a selected brand of biscuit. The study was carried out using 140 supermarket consumers in Colombo district, a known lead market in Sri Lanka. Primary data were collected using convenient sampling technique by administering a pre-tested questionnaire and analyzed using descriptive statistics and binary logistic regression model. As per the results, income level of the customer, age and product attributes had positive significant influence while perceived quality of the brand (0.082 level of significance) depicted negative significant influence on seeking product quality certifications at the point of purchase. In addition, customers assured the product quality via the product brand, price of the product, physical appearance and associated quality certifications with the product respectively when purchasing the biscuits. However, customers in any income level had not given the priority for the quality certifications during the purchase. Moreover, the most educated customers (79.5%) and majority of female (86.5%) seek for the quality certification when purchasing biscuits from supermarkets. Further, the awareness of food quality certification increased with the education among biscuit purchasing customers. In addition to the assurance given by the food quality and safety certifications, consumers had their own definitions to declare the quality of the product when making the purchasing decision.

Keywords: Quality standards, Certifications, Consumer purchasing behaviors, Safety

Quality Improvement of Coconut Butter Spread

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Coconut butter spread is a delicious product from whole coconut meat and oil separation at top of the product has been identified as a major defect which can leads to consumer dissatisfaction. Thus, this study was conducted to evaluate the effect of stabilizers and homogenization speeds on the layer separation of coconut butter spread. Coconut butter spread was prepared with desiccated coconut, peanut, coco powder, sugar and salt by grinding method. Level of coco powder (1.5, 2 and 2.5% (w/w)) was changed to select the best product through a sensory evaluation of five-point hedonic scale with 30 number of human objects. Four combinations of stabilizers Soy Lecithin (SL), Sodium Caseinate (SC), Sodium Stearoyl Lactylate (SSL) and SC+SSL with two levels (0.25 and 0.5% (w/w)) and two levels of homogenization speeds (11,000 and 19,000 rpm) were evaluated as a three factor factorial design with three replicates. The height of separated oil layer was measured after two-week interval and best five treatments were subjected for quality analysis. Free fatty acid (FFA) content, peroxide value and moisture content were analyzed and best three treatments were selected for sensory evaluation with control (without stabilizers and homogenization). Proximate and microbial analysis was done for the selected best product. Data was analyzed by ANOVA ($p<0.05$) using Minitab software package. The sensory result revealed that, 2% (w/w) coco powder was provided the highest consumer preference. The lowest level of oil separation (0.18 mm) was observed on 0.5% (w/w) of SC+SSL stabilizer with 19000 rpm and it contained significantly low level of FFA (0.17±0.02%) and moisture content (0.81±0.04%) and highest consumer preference. This product conations 1.42±0.01% moisture content, 41.53±2.8% fat, 1.8±0.002% ash, 8.68±1.18% fiber and 16.96±0.98% protein. SC+SSL with 0.5% (w/w) ≤ level and 19,000 rpm ≤ homogenization is preferred to overcome the oil layer separation in coconut butter spread.

Keywords: Coconut butter spread, Stabilizers, Homogenization, Layer separation, Free fatty acid

Factors Affecting on the Continuous Improvement of ISO 22000:2005 Food Safety Management System; Case Study of a Cinnamon Processing Plant

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Food safety is a fundamental public health concern for every performer in the food supply chain because wide number of food borne hazards present in the foods may cause many health problems and adverse effects for the global food trade. International organization for standardization has developed the international standard; ISO 22000 which specifies the basic requirements for a food safety management system in an organization. In order to enhance the food safety while reducing risks associated, it is vital to maintain the continuous improvement of this food safety management system in any processing plant. Even in cinnamon processing plants, it is essential to maintain the acquired long standing reputation in the international market. Therefore, this study was aimed to identify different organizational factors and the severity of the influential factors on continuous improvement of ISO 22000:2005 food safety management system. The primary data were collected from all respondents (30) who work in the plant through self-administered questionnaires and collected data were analyzed using descriptive analysis, Pearson correlation analysis and multiple linear regression model. According to the results, there were strong positive linear relationships between all the organizational factors and continuous improvement of ISO 22000:2005 food safety management system (R^2=0.851; $p< 0.01$). Management commitment ($p<0.05$) and contribution of human resources for food safety management ($p<0.1$) significantly affected on continuous improvement of ISO 22000:2005 food safety management system. The study suggested to concern more on organizational factors along with the food safety standard and to provide sufficient training to enhance the knowledge of the workers about food safety, food safety risks and issues, and food safety requirements.

Keywords: Food safety standards, Organizational factors, Management commitment

Genetics & Biotechnology

- Plant Breeding and Varietal Improvement
- Genetics and Breeding
- Biotechnology
- Recombinant DNA Technology
- Tissue Culture

Heterosis Among Pole Bean Genotypes for Yield and Yield Associated Traits

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Heterosis or hybrid vigor refers to the enhanced phenotype of hybrid progeny relative to their inbred parents. In Sri Lanka, no information is available on better parents in relevance to heterosis for used in pole bean breeding programs. The present research was undertaken to assess heterosis among 20 pole bean F1 hybrids for yield, yield-associated traits, and short age. Twenty F1 hybrids and their five parents were planted during Maha season in 2016/2017. Yield and its components, architectural and phenological traits were considered in the study. Statistically significant differences were observed between the 25 genotypes for most of the traits studied. Analysis of better parent and standard heterosis showed significant heterosis for yield per plant and some were positive. The extent of better parent heterosis for yield ranged from -45.31% (Black Capri x CNC) to 63.64% (Black Capri x Bandarawela Green). The maximum economic heterosis (68.75 %) was observed from the cross Black Capri x Bandarawela Green. Significant better parent heterosis was also observed for yield-associated traits. Expression of significant better parent heterosis for yield and other important traits was frequent in combinations of parents from different growth habits suggesting that these crosses could be further considered in the breeding program aiming for high yield and short age.

Keywords: Better parent, Heterosis, Pole bean, Yield

Screening of Rice Breeding Lines for Resistance to Brown Plant Hopper (*Nilaparvata lugens*)

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Rice productivity is greatly affected by Brown Plant Hopper (BPH) (*Nilaparvata lugens*), and it causes significant yield losses in rice production in Sri Lanka. Identification of resistant rice varieties is an important step to minimize the damage caused by BPH and to increase rice productivity. The study evaluated the damage of BPH in fifty rice breeding lines with two check varieties of Bg 300 (Resistant) and Bg 380 (Susceptible) by using standard seed box screening test. Rice breeding lines were scored (0 to 9 scale) following the standard evaluation system. Results indicated significant differences among the Rice breeding lines. Susceptible check recorded 16 days for the appearance of 90% wilting level. Out of fifty rice breeding lines, records showed that seven lines were resistant, eight lines were resistant / moderately resistant, Twenty two lines were moderately resistant, seven lines were moderately resistant / moderately susceptible, and the remaining six lines were susceptible in 16 days. There were three breeding lines which were identified with higher susceptibility than the susceptible check variety. This standard method adopted divided fifty breeding lines into six groups in the range of susceptibility to resistance to BPH. There are seven rice breeding lines that can be recommended as resistant to Brown plant hopper.

Keywords: Brown plant hopper, Resistant, Rice lines, Standard seed box screening test, Susceptible.

Screening of *Arachis hypogaea* L. (Groundnut) Breeding Lines for Seed Size and Short Duration under Rain Fed Conditions

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There is a higher demand for large seeded groundnuts (100 seeds weight ≥ 70g) in confectionary food industry in Sri Lanka. Only two large seeded groundnut varieties have been recommended by the Department of Agriculture to-date. Higher demand exists for large seeded, short duration groundnut varieties which can be cultivated under rain fed conditions to be used as confectionaries. This research was conducted to screen groundnut breeding lines for seed size and short duration. Seven breeding lines developed were evaluated with Walawa and Lanka Jumbo; the recommended varieties as check varieties. There is no significant difference among breeding lines and check varieties in pod yield and all yielded more than 2500 kg ha $^{-1}$ pod yield. Except one line, all the other lines recorded 100-seed weight values greater than 70 g. Two lines [(Tissa × Nakate Yukata) , (ICGV 06216 × Ampara)] recorded the highest 100-seed weight values of 85 g .These two lines were not significantly different with Walawa and they showed significantly better performance than Lanka Jumbo. The same two lines recorded 105 days to maturity while Walawa and Lanka Jumbo recorded 120 and 110 days respectively. Hence, these two lines performed better than Walawa and Lanka Jumbo. They can be selected as large seeded, shorter duration groundnut lines which can be cultivated under rain fed conditions in Sri Lanka.

Keywords: Large Seeded, *Arachis hypogaea* L, breeding line, short duration, rain fed

Screening of Bean (*Phaseolus vulgaris*) Breeding Lines against Fusarium Wilt Caused by *Fusarium oxysporum* f. sp. Phaseoli

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Fusarium oxysporum f. sp. *Phaseoli (Fop)* is an important pathogen that causes Fusarium wilt in common bean (*Phaseolus vulgaris* L.). This disease is one of the most harmful diseases of bean worldwide. Use of resistant cultivars is the most reliable method of fusarium wilt prevention. There are no resistant varieties found in Sri Lanka so far. Identification of resistant breeding lines will help breeders to develop resistant or moderately resistant bean varieties. The objective of this study is to identify resistant/moderately resistant bean breeding lines against *Fusarium oxysporum* f. sp. *Phaseoli* among 19 common bean breeding lines developed at RARDC Bandarawela, Sri Lanka. These lines were evaluated with 2 susceptible controls (Wade and Keppetipola Nil) under greenhouse condition .Screening of bean breeding lines was done by transplanting inoculated seven day old seedlings filled with pasteurized sand: soil medium (4:1) into in disposable plastic cups. After 10 days of inoculation the disease symptoms such as chlorosis, necrosis and wilting of leaves were started appearing including 2 susceptible controls. Observations were taken after 21 days of inoculation and Disease Severity Index (DSI) was used to calculate on a resistant to susceptible. Out of 19 bean breeding lines including two control varieties it was identified 9 resistant (DSI 1-3), 10 intermediate (DSI 3.1 -6.0) , 2 susceptible (DSI 6.1-9.0) breeding lines. These bean breeding lines can be classified into three groups as resistant, intermediate and susceptible.

Keywords: Common beans, Breeding lines, *Fusarium* wilt, Inoculation

In-vitro Study on Geosmin and 2-Methylisoborneol Producing Four Species of Native Cyanobacteria

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The production of odiferous metabolites, such as Geosmin and 2-methlyisoborneol (2-MIB) cause muddy and moldy taste and odor in water is a major limitation in safe and adequate provision of potable waters in worldwide. The biological functions of these odorants have not known, and cyanobacteria are the major producers of Geosmin and 2-MIB in natural waters as a result of their secondary metabolites. Objective of the current study was to investigate four laboratory cultured cyanobacteria's ability to produce Geosmin and 2- MIB. Production of Geosmin and 2- MIB was studied using native cyanobacteria isolated from Unnichchi tank in Baticolloa district, Jayanthi tank in Ampara district and Padawiya tank in Anuradhapura district where taste and odour issues are prevailing. Isolation of cyanobacteria was carried out using dilution and spread plate method by maintaining cultures in BG 11 medium with antibiotics. The cultures were identified as *Oscillatoria* sp., *Psudoanabena* sp., *Lyngbya* sp., and *Nostoc* sp. using the 16s rRNA sequencing. 10 ml aliquots of two months old axenic cultures were subjected to Solid Phase Micro Extraction (SPME) and Gas Chromatography Mass Spectrometry (GC/MS) analysis with BG 11 culture medium as control. The concentration of Geosmin produced from the cyanobacteria were ranged between 10.8 ng/L to 162.6 ng/L whereas 2- MIB levels ranged from 50.8 ng/L to 532.5 ng/L. Axenic cultures of *Nostoc* sp. recorded the highest Geosmin level (162.6 ng/L) and highest 2- MIB level was detected from *Psudoanabena* sp. (532.5 ng/L). Further *Nostoc* sp. recorded a significant high level of 2- MIB level (379.6 ng/L) compared to *Oscillatoria* sp. and *Lynbya* sp. ($p < 0.05$). It can be concluded that above species are commonly available cyanobacteria species in Sri Lankan water bodies and popular Geosmin and 2- MIB producers.

Keywords: Geosmin, 2-Methylisoborneol, Cyanobacteria, Solid phase micro extraction, Gas chromatography mass spectrometry

Detection of Endosperm Specific Gene Expression in Ferritin Rich Transgenic Rice Seeds

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Iron deficiency is a serious nutritional problem that is encountered by around 30% of the world population, especially in developing countries like Sri Lanka. Rice which is the staple food of Sri Lanka is deficient in iron. Increasing the iron content in food staples by genetic engineering may help to alleviate this problem. Ferritin is a major iron storage protein in both animals and plants which can store up to 4,500 iron atoms in its central cavity. Transgenic rice seeds with increased ferritin content have been prepared by transforming soybean ferritin gene along with a seed specific globulin promoter into rice seeds. The objective of this study is to detect the endosperm specific expression of ferritin in this ferritin rich transgenic rice seeds. Total RNA was isolated from ferritin rich transgenic seed and leaf samples from same plant of both BG94-1 and BG 300 rice varieties. Complementary DNA (cDNA) was prepared by using random primers and it was used as a template for gene/ferritin specific PCR. The expression of ferritin was confirmed by agarose gel electrophoresis, comparing with the ladder and the positive control. The presence of a band at 750 bp indicated that ferritin has been expressed in both varieties of BG94-1 and BG 300 while the leaf samples did not give a band due to endosperm specific expression of ferritin. This ferritin rich transgenic rice seeds express endosperm specific ferritin. Further studies will have to be carried out for several generations of transgenic plants and number of field trials will be needed before commercialization of the final ferritin rich rice seeds.

Keywords: Ferritin, cDNA, Transgenic rice, BG94-1, BG 300

Rapid Protocol for Isolation of PCR-Amplifiable DNA from Plants Containing High Level of Polysaccharides and Polyphenols

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Extraction of pure and high molecular weight genomic DNA from plants containing higher amount of proteins, polysaccharides, polyphenols and other secondary metabolites which interferes the isolation of pure DNA, is a prerequisite for PCR marker based molecular authentication methods such as DNA profiling. Medicinal plants contain high levels of polyphenols, polysaccharides, tannins and secondary metabolites. A medicinal plant *Cassia auriculata* was used as the study plant and an inexpensive and robust DNA extraction protocol that does not need liquid nitrogen was developed. The method is based on modified Cetyltrimethylammonium bromide (CTAB) extraction protocol. In this method, DNA was precipitated with salt based ethanol to reduce polysaccharides and salt contaminations by replacing isopropanol precipitation. The chilled incubation step at -20 ˚C for overnight was replaced with that particular condition at -80 ˚C for 2 hours to reduce protein and other co-precipitations. The use of increased β-mercaptoethanol concentration of 2% in CTAB extraction buffer removes phenolic and protein contaminations. With above modifications, average yield of extracted DNA increased to 740.00 ± 47.55 µg mL^{-1}. The mean $OD_{260/280}$ and $OD_{260/230}$ values were 1.82 ± 0.03 and 1.85 ± 0.07 respectively, indicating minimal levels of contamination. The optimized protocol was successfully tested for sensitivity and consistency using RAPD by arbitrary primer OP-U20 with 0.37 µg of DNA in 25 µL reaction volume. To our knowledge, this is the first attempt at isolating DNA profiling based PCR amenable genomic DNA from *C. auriculata* leaves. This protocol is suitable for extracting genomic DNA for DNA profiling and other downstream applications of medicinal plants.

Keywords: Cassia auriculata, CTAB protocol, RAPD, DNA profiling

Optimization of PCR Protocols for Amplification of ITS1, ITS2, rbcL and matK Genomic Regions of *Alpinia galanga* and Related Species

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Polymerase Chain Reaction (PCR) is a method widely used in molecular biology to make many copies of a specific DNA segment of which a single copy of a DNA sequence is exponentially amplified to generate many copies. Conditions required to amplify specific genomic regions are different for plant to plant. The aim of this study was to optimize PCR protocols to amplify ITS1, ITS2, rbcL and matK genomic regions of *Alpinia galanga, Alpinia calcarata, Alpinia malaccensis, Alpinia purpurata, Hedychium coronarium and Hedychium coccineum*. The protocols of PCR were optimized by changing concentrations of template DNA, dNTPs, Mg^{2+}, Taq DNA polymerase, primer and primer annealing temperatures. At optimized conditions, reproducible amplifiable products were obtained and observed using 2% agarose gel electrophoresis. All genomic regions showed amplification in *Alpinia galanga* and other related species. For better performance in PCR high quality genomic DNA was required. In low annealing temperature and high primer concentrations primer dimers were observed. The developed PCR protocol was a total volume of 30 µl of PCR reaction mixture contained a final concentration of 1x buffer, 0.2 mM Mg^{2+}, 2 U of Taq DNA Polymerase. For ITS1 final forward and reverse primer concentrations were 3 µM. For ITS2, rbcL and matK final concentrations of forward and reverse primers were 1 µM. The optimized PCR program was; initial denaturation at 94 ^{0}C for 5 minutes, 42 cycles of denaturation at 94 ^{0}C for 1 minutes, annealed at 56 ^{0}C for 1 minutes (ITS1), 54 ^{0} C for 1 minute (ITS2 and rbcL) and 47 ^{0}C for 1 minute (matK), extension at 72 ^{0}C for 2 minutes followed by final extension step at 72 ^{0}C for 7 minutes. The protocols established could be employed in producing reproducible DNA fragments for determining the diversity of *Alpinia galanga* and related species and studies relating to DNA barcoding and phylogeny.

Keywords: *Alpinia*, ITS1, ITS2, matK, rbcL, PCR

Foliar Pathogenic *Colletotrichum* species Associated with Cultivated Rubber Trees in Sri Lanka

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Colletotrichum leaf disease (CLD) is regarded as one of the major threats on rubber trees worldwide. Due to recent revolutionary changes in species numbers in the genus *Colleotrichum* based on molecular data, it is essential to re-assess the *Colletotrichum* species associated with rubber trees in Sri Lanka. The objective of this study is to identify *Colletotrichum* species associated with rubber plants in Sri Lanka using morphology and DNA barcoding. Samples with leaf spots were collected randomly from rubber trees at selected sites in Colombo and Matale. Single spore isolation technique was followed to obtain five pure cultures of *Colletotrichum* spp. and their morphological characteristics were observed. Internal transcribed spacer (ITS) loci of all isolates were sequenced. Sequences were initially identified based on similarity search at NCBI and phylogenetic analysis was performed to further confirm the relative phylogenetic placement of *Colletotrichum* species. Pathogenicity tests were carried out to confirm the pathogenicity of the species and the Koch's postulates were proven for potential pathogens. According to the morphological and molecular data, those isolates belong to *C. gloeosporioides, C. gigasporium* and *C. truncatum* species complexes. Two different species grouped within *C. gloeosporioides* complex showed highest growth rates in Potato Dextrose Agar (PDA) and Malt Extract Agar (MEA) whereas *C. gigasporium* and *C. truncatum* showed the highest growth rate in PDA and MEA respectively. Typical CLD symptoms were observed with C. *gloeosporioides* complex species after pathogenicity testing whereas *C. gigasporium* and *C. truncatum* were also able to colonize and produce spore masses on rubber leaves. According to our knowledge this is the first record of *C. gigasporium* and *C. truncatum* associated with rubber plants in Sri Lanka. Therefore, this study reveals the unknown diversity of *Colletotrichum* pathogens associated with cultivated rubber trees.

Keywords: Leaf diseases, Plantation crops, DNA barcoding, Species complexes

Acknowledgement: This work is supported by University of Sri Jayewardenepura undergraduate research grant and Martin-Baker Award from Mycological Society of America.

Investigating the Presence of *Candidatus* Liberibacter asiaticus in *Murraya koenigii* and *Citrus* spp. from Selected Areas in Sri Lanka

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Citrus Greening (CG) disease is the most detrimental bacterial disease for citrus and it is caused by *Candidatus* Liberibacter asiaticus (CLas). In Asia, CG is mainly transmitted by Asian Citrus Psyllid (ACP) which is recognized as a major pest in *Murraya koenigii* (curry leaves). This study was carried out to investigate the presence of CLas in *Murraya koenigii* and *Citrus spp*. in selected locations, where fresh curry leaves are harvested for exporting. Leaf samples of curry leaves and *Citrus spp.* were collected from Anuradhapura, Puttalam and Badulla areas. The presence of CLas was tested in twenty-seven leaf samples of each plant using DNA extraction by modified CTAB method followed by Polymerase Chain reaction (PCR). CLas presence was detected by amplification of 1160 bp fragment of 16s rRNA coding gene of CLas by using OI1 and OA1 as forward primers and OI2c as common reverse primer and by amplification of 703 bp and 669 bp fragments of rplKAJL-rpoBC operon gene of CLas using forward primer A2 and reverse primer J5. None of the curry leaf samples produced any amplicon indicating zero presence of CLas, while Citrus leaf samples produced amplicons in all three areas indicating the presence of CLas. Citrus in Anuradhapura area displayed the lowest percentage (40%) of presence, while the highest percentage (80%) was observed from Badulla area. Citrus in Puttalam area showed 53% of presence. Results indicated that, within three selected areas, CLas is totally absent in curry leaves, while CLas presence is detected in *Citrus spp*. in same fields. CG is restricted to *Citrus spp.* in Anuradhapura, Puttalam and Badulla areas and *Murraya koenigii* (curry leaves) that is host for ACP is free of CLas.

Keywords: Citrus greening, *Candidatus Liberibacter asiaticus*, *Murraya koenigii*, Polymerase chain reaction

Study the Mitochondrial COI Gene Sequence Variation of Two Isolated Populations of *Cephalopholis sonnerati* (Valenciennes, 1828) in East and West Coasts of Sri Lanka

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Cephalopholis sonnerati (Thambuwa) remained as one of the main reef fish species in the marine fishery sector in Sri Lanka. The major problem associated with the fish species is the huge population reduction in last few years due to the overexploitation. At present, this species has been protected under the fisheries law and this decision has been taken as a precautionary conservation and management measure. It is essential to conduct fish stock studies to assessment of sustainable fishing levels based on stocks. *C. sonnerati* in East and West coast may be from two different fish stocks due to the limited breeding between the populations. Due to the restriction of gene flow between two isolated populations, nucleotide level variation would provide a basic idea about population and stock structure. The study was conducted with the aim of identification of genetic variation at the mitochondrial *cytochrome oxidase* subunit I (COI) gene in two isolated populations. Fish samples were collected from east coast (Ampara and Batticaloa) and west coast (Chilaw). DNA was extracted by using CTAB method. PCR reaction was performed by using primers designed by COI gene sequences. PCR amplified products were sequenced and sequences were analyzed using BLASTn at NCBI and were aligned by using BioEdit and ClustalW sequence alignment tools. Even though the COI region is highly conserved region, single nucleotide polymorphism (SNP) was identified at 336th position (T/C) in both west and east coast *C. sonnerati* samples. To confirm the SNP in COI region more samples need to be used in the future studies. Due to the conserved nature of COI region very low nucleotide level difference was observed and all individuals shared similar sequences pattern. It can be confirmed that the two populations may still from the same stock. To confirm that it can be used microsatellite markers along with SNPs in future. This study provides a basic for future genetic stock studies.

Keywords: *Cephalopholis sonnerati*, Mitochondrial COI region, Single nucleotide polymorphism, Reef fish

Effect of *Sargassum wightii* (Seaweed) Extract on *In-vitro* Sub-Culture Medium of *Dendrobium* Orchid

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Dendrobium is one of the most beautiful orchid varieties having high demand as a cut flower as well as a potted plant. Large scale commercial production is possible only through vegetative propagation such as tissue culture. High cost of production is a major drawback of tissue culture which involves higher expenses for chemicals. This study focused on identification of bio-stimulatory effects of a seaweed (*Sargassum wightii*) extract on *in-vitro* sub culture medium of *Dendrobium* for quality plantlet production. Two experiments were carried out with 20 treatments in 10 replicates where, MS (Murashige and Skoog) basal medium with BAP (6-Benzyl Amino Purine) and without BAP were used for experiment one. For experiment two KnC (*Knudson C)* basal medium was used with coconut water, banana pulp and without coconut water, banana pulp. Treatments were prepared with combination of seaweed extract of 5%, 10%, 25% and 40% concentrations for above basal media. MS medium with BAP and KnC medium with coconut water, banana pulp without adding seaweed extract were used as control. Plantlets in MS medium with BAP and 10% seaweed extract showed significantly higher ($p<0.05$) plant height, number of shoots, number of leaves and dark green color leaves whereas higher number of roots were recorded in MS medium without BAP but with 10% seaweed extract compared to the control. Plantlets in KnC medium supplemented with coconut water, banana pulp and 10% seaweed extract showed significantly higher ($p<0.05$) plant height, number of shoots, number of leaves, number of roots and dark green color leaves compared to the control. Comparatively, MS medium with BAP and 10% seaweed extract showed good performance, which is suitable for commercial plant production.

Keywords: *Dendrobium* Orchid, KnC medium, MS medium, Seaweed extract

Identification of Vectors for *In-vivo* Protein Overexpression in Introducing Drought Resistance: A Review

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The prolonged lack of rainfall is a major abiotic stress affecting crop productivity in Sri Lanka. *In vivo* protein overexpression to induce drought resistance is frequently studied globally however; the selection of a most suitable vector for gene transfection has been a challenge for high protein yield. This study aims to review such possible vectors, through a thorough published literature survey at 'Google scholar' and 'PubMed' with search terms 'drought resist*', 'drought tolerant*', 'vector', 'overexpression'. A late embryogenesis abundant protein gene *OsLEA3-1* overexpressed with three binary expression constructs (*OsLEA3-S/A/H*), by inserting the full length cDNA into backbone vectors pCAMBIA1301-S/A/H respectively, with double *CaMV* 35S, rice Actin1 and HVA1-like promoter, followed by *Agrobacterium* transformation. All other constructs OsLEA3-S/-H had higher grain yield than wild type under stress except OsLEA3-A. Over expression levels are 63% 56% and 46% for *OsLEA3-S/A/H*, respectively. Protein coding region of OsbZIP72 in vector pCAMBIA1300S to construct pCAMBIA1300S-OsbZIP72; and a promoter of drought tolerance rice cultivar IRAT109 in a pCAMBIA1381xb-GFP vector to control GFP expression and *Arabidopsis* BnLEA4-1 in pGEMT-BnLEA4-1 vector transfected via *Agrobacterium* are few examples at global scale. However, no published studies in Sri Lanka were found during the literature search. Therefore, cloning of drought tolerant gene to a crop plant followed by *in vivo* overexpression to stimulate the drought tolerance is a promising biotechnological advancement in agriculture. Literature showed vectors can be modified to fit to an individual crop product for *in vivo* overexpression of drought tolerant genes. It is recommended to extend the review to analyse characteristics for a suitable vector include compatibility, linker region, and screening genes to develop a complete guide for selection of vector in *in vivo* protein overexpression for drought resistance.

Keywords: Drought tolerance, Agriculture, Overexpression, Vector.

Importance of Genetic Diversity and Phytochemical Assessment of *Madhuca* spp. in Sri Lanka: A Review

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Madhuca is a large evergreen tree belonging to the family Sapotaceae distributed in many Asian countries including Sri Lanka. The aim of this review was to identify potential applications of *Madhuca* spp.in Sri Lanka to be developed into a research prospective in genetic and phytochemistry analysis. Literature survey was done using "Google Scholar" search engine and "PubMed" database using search terms "Madhuca"," Genetics"," Phytochemistry". Altogether twenty-two research studies were retrieved on phytochemical analysis, pharmacological profiles but fewer in its other utilizations and genetic analysis. Five research articles were found on phytochemistry studies and three articles were about modified DNA isolation methods and genetic diversity analysis using *Madhuca* spp. in India. Studies showed that all parts of the *Madhuca* tree carry a number of medicinal properties and is rich in secondary metabolites. Literature evidence depicted it as a multipurpose forest tree, source of food and nutrition, pharmaceutical ingredient, bio-fertilizer and bio-fuel. This search identified seven *Madhuca* species currently found in Sri Lanka of which four of them are endemic. Being a plant species with a wide scope of potential applications, to date there are only one research available in published literature on phytochemical analysis of four *Madhuca* species found in Sri Lanka. None of supporting materials were found on genetic studies in genus *Madhuca* in Sri Lanka. Hence this raises the demand for such phytochemical analysis of different *Madhuca* spp. in Sri Lanka. Developing methods to extract genetic data, molecular authentication studies via molecular barcoding to fill the gaps in phenotypic and genotypic characterisation, storing the genetic data in databases for public access for future research purposes and efficient sustainable germplasm management will widen the research scope and potential application development of this invaluable plant in Sri Lanka.

Keywords: *Madhuca*, Endemic, Phytochemistry, Molecular genetics

Screening and Quantification of Tetracycline and Sulfonamide Resistance Genes in Natural Environmental Samples

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Screening of antibiotic resistance is important factor for assessing risk of antibiotic resistance in aquaculture environment. In this study, tetracycline (*tet A* and *tet M*) and sulfanomide (*sul 1* and *sul 2*) resistance genes were screened in 24 sampling locations including marine water samples at different levels (100, 500 and 1000 m), lagoons (Chilow, Puttalam), rivers (Kelani, Kalu, Walawe, Mahaweli) and from Horton plains. The Tetracycline (TET and OTC) and Sulfanomide (SUF) contamination levels in the sampling locations were analyzed by using High Performance Liquid Chromatography (HPLC). DNA was extracted and Polymerase Chain Reaction (PCR) method was followed to screen the presence of Antibitic Resistance Genes (ARGs) in the samples. Real time PCR assays were employed to quantify ARGs. None of the samples were shown the contaminations of tetracycline and sulfonamides. The *tet (M)* gene was detected in 7 sampling sites. From the tested ARGs, both *tet A* and *tet M* were found at 3 marine samples (100m), 2 lagoon samples, whereas both *sul 1* and *sul 2* were recorded at only in one lagoon sample. No resistance genes were found in >100 m depth marine samples and in any river samples. The average concentrations of the *Sul 1* and *Sul 2* was ranged between 0.12×10 – 1.56×10 copies/ml, 0.05×10 – 0.56×10 copies/ml in lagoon samples while *tet M* and *tet A* were ranged 0.11×10 - 1.23×10^2 copies/ml, 0.13×10 – 4.56×10 copies /ml in marine samples. The presence of tetracycline and sulphonamide resistance genes may limit the effectiveness of antibiotics in treating fish illnesses, thereby causing a potential risk to the aquaculture industry.

Keywords: Antibiotic resistance genes, Tetracycline, Sulphonamide

Development of Explant Sterilization Protocol for *In-vitro* Propagation of *Hydrocera triflora* (Marsh Henna)

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Hydrocera triflora is a demanded, commercially valuable, perennial, ornamental aquatic plant, distributed within the *Indo-Malaysian* region and still not developed some *in-vitro* sterilization protocol for this species. This study was conducted to analyze the effect of surface sterilization treatments on *H. triflora* explants for development of *in-vitro* explant's surface sterilization protocol. Explants (shoot tip, node, and Internode) were cultured in full strength Murashige and Skooge (MS) medium, supplemented with 3% sucrose level and 3:1 BAP (6-Benzylaminopurine): NAA (Naphthalene Acetic Acid) concentration at 5.70 pH. Effect of sterilization treatments with factorial combinations; 15% to 30% Sodium hypochlorite (NaOCl) (1 to 5 minutes), 70% Ethanol (30 s) on explant surface sterilization with pre-treatment (Topsin fungicide, Teepol detergent and Tween 20) and without pre-treatment for each explants were determined after 10 days. All the explant types' sterilized without pre-treatment indicated 100% contamination by fungal infection within 2 days. In 20% to 30% NaOCl with 70% Ethanol (pre-treated) indicated that there was no significant difference with the number of contaminants and the treatments for all explant types. All the explant types in this treatment were contaminated by bleaching effects. In 15% to 20% NaOCl with 70% Ethanol (pre-treated) indicated that there was a significant difference between treatments for the average number of contaminants (fungal infection). Lowest average number of contaminants for shoot tips (0.00), nodes (0.16) and internodes (0.16) represented the best treatment for explant sterilization, which was provided by 18%, 19% and 18% NaOCl and 70% Ethanol (pre-treated) respectively. The most effective explant sterilization protocol (pre-treatment, 18 to19% NaOCl and 70% Ethanol) developed from this study can achieve the highest number of healthy explants for *in-vitro* propagation of *Hydrocera triflora.*

Keywords: *Hydrocera triflora,* Explant, Surface sterilization, *In Vitro* Propagation, Sodium hypochlorite

Formulation of Specific Culture Media for *In-vitro* Cultivation of *Exobasidium vexans* Massee

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Blister blight is the most important and destructive foliar disease of tea that caused by an obligate parasite *Exobasidium vexans* Massee. Further investigation of this fungus in *in-vitro* condition has been restricted due to non-availability of effective culture media. This study has been conducted to find an effective culture media for the pathogen. Disease infected leaf samples for inoculation and blister blight susceptible healthy tea leaves for media preparation were collected around Uva Wellassa University of Sri Lanka, Badulla. The tested media were prepared by referencing standard PDA media using dextrose and agar with 50 g of dried fresh tea leaves powder, 250 mL of hot water tea extraction, 0.7% instant green tea and 0.7% instant black tea instead of potato as four treatments in four replicates using PDA as negative control and 0.7% calcium carbonate amended PDA as positive control. Each medium was inoculated with 30 spores mL^{-1} pure spore concentration of the pathogen and incubated under 28°C for observations. Colony diameter and number of days to show visible growth and respective colony morphologies on each media were measured. The Koch's postulate was done by whole plant inoculation method for verification of the pathogen. The average growth area on the media with fresh tea leaf powder, hot water extraction, instant green tea, instant black tea were recorded as 60.82 cm^2, 36.32 cm^2, 9.62 cm^2, 8.55 cm^2 respectively. The number of days to show visible growth was same for all media. The culture media with particle size 0.5 mm dried fresh tea leaf powder that prepared using blister blight susceptible cultivar TRI 2025 was recorded the highest growth. The minimum growth was recorded in the media with instant black tea. Standard PDA media with particle size 0.5 mm dried fresh tea leaf powder that prepared using blister blight susceptible cultivar TRI 2025 is the best formulation for *in-vitro* cultivation of *Exobasidium vexans* Massee.

Keywords: Blister blight, *Exobasidium vexans* Massee, Culture media, *In-vitro*

Optimization of PCR Protocols for SSR Markers Based Molecular Characterization of *Camellia sinensis* (Tea)

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Use of SSR markers in molecular characterization of tea is useful in differentiation among tea collections to distinguish closely related genotypes. Polymerase Chain Reaction (PCR) is used to generate many copies of a selected DNA segment determined by SSR markers. Amplification of reproducible DNA segments is essential and different for different SSR markers. Objective of this study was to optimize PCR protocols for Camsin M1 and Camsin M5 tea SSR markers. PCR protocols were conducted for reaction volume of 30 µl. Concentrations of premix components were changed for 10x buffer from 2 µl to 3 µl, 2 mM dNTPs from 2 µl to 3 µl, forward and reverse primers from 0.4 µl to 3 µl, Taq DNA polymerase from 0.2 µl to 0.4 µl and DNA template from 1.2 µl to 6 µl per reaction. 3 µl of 2 mM $MgSO_4$ was added in premix preparation and number of cycles in PCR program were increased to 42 cycles from 35. For Camsin M1 annealing temperature was increased to 52 ^oC while 60 ^oC was used for Camsin M5. 2% agarose gel electrophoresis was used to observe PCR products and clear DNA bands were obtained for optimized PCR protocols with 1x buffer, 0.2 m M $MgSO_4$, 0.2 mM dNTPs, 1 µM forward and reverse primers, 0.7 U Taq DNA polymerase and 10 ng DNA template of final concentration for one reaction in premix for both SSR markers and 42 cycles in the PCR program. Annealing temperature was optimized at 52 ^oC for Camsin M1 and remained at 60 ^oC for Camsin M5. $MgSO_4$ was used as the Mg^{2+} source along with the Mg^{2+} ions included in the 10x PCR buffer. Optimized PCR protocols could be used for further analysis of SSR markers based molecular characterization in *Camellia sinensis* (Tea).

Keywords: PCR protocols, SSR markers, Molecular characterization, *Camellia sinensis*

Effect of Growth Regulators on *In-vitro* Shooting of *Calathea ornata* for Commercial Cultivation

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Clathea ornata is a foliage plant belongs to the family Marantaceae, having high commercial value all over the world as a house plant due its attractiveness. This study, focused to develop cost effective shoot induction protocol to obtain high number of shoots for commercial usage. The effects of different sterilization techniques, explant types, various combination and concentration of plant growth regulators on shoot induction were studied. The meristem explant showed high induction rate of shoots with minimum contamination percentage when explant treated with 20% (v/v) NaOCl for 10 minutes, 0.3% HgCl2 in 15 minutes and 70% alcohol 2 minutes. Further, the maximum number of multiple shoots were obtained in MS basal medium supplemented with 3.0 mg l^{-1} 6-Benzyl Amino Purine (BAP) and 3.5 mg l^{-1} Naphthalene Acetic Acid (NAA). Initiated shoot then sub cultured for shoot multiplication in terms of highest number of shoots and shoot length was observed in MS media in combination with BAP 3.0 mg l^{-1} with NAA 3.5 mg l^{-1}.

Keywords: Sterilization, NAA, BAP, Sub culture, In-vitro shoots

Hospitality & Events Management

- Quality Assurance in Hospitality and Event Industry
- Innovative Practices in Hospitality and Event Industry
- Best Practices for Sustainability in Hospitality and Event Industry
- Social Media and Digital Applications in Hospitality and Event Industry
- Gastronomic Tourism
- Service Quality Management in Hospitality and Event Industry
- Entrepreneurship in Hospitality and Event Industry
- Hospitality, Event Marketing and Management

Impact of Tourism Education On Job Performance of Tourism Graduates from State Universities in Sri Lanka

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Tourism is one of the fastest growing umbrella industries in the world. Each one in eleven jobs in the world are from tourism sector. It is equally important to have well trained, educated and skilled work force for high quality performance. Despite the rapid growth in the provision of tourism higher education in the past 40 years, uncertainties remain about the content and nature of tourism degrees and how these are aligned with the needs of the tourism industry. Some research has been done on designing tourism higher education curriculum but the extent to which tourism higher education meets the industry needs and the job performance of the graduates has not yet been closely investigated. This study aims to identify the impact of tourism education on the job performance of the tourism graduates. Conceptual framework was developed to outline the research process. Sample consisted 160 respondents by covering all the four state universities providing tourism degree programs in Sri Lanka. An online survey was conducted to collect the relevant data. Data was analysed by using descriptive statistics, confirmatory factor analysis, path modelling through SPSS and Smart-PLS (SEM). The study found considerable variance between tourism education and job performance and there is a positive moderate impact from tourism education to the job performance. Learning outcomes have a moderate positive relationship with job performance. Tourism graduates have a good perception about the tourism education in order to fulfil the industry requirements. As the recommendations tourism curriculum must be well planned and rich with more practical exposure. The faculty members must provide a great support for the undergraduates in accomplishing their career objectives and the learning outcomes. The learning environments must facilitate the supportive exposure in order to get fulfil the learning outcomes of the courses.

Keywords: Tourism education, Job performance, Learning outcomes, Tourism graduates, Structural equation modelling

Investigating Intercultural Workplace Relationships: Hotel Industry Employees' Perspective in Sri Lanka

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Hotel industry is an emerging industry in Sri Lankan service sector which consists of highly diversified workforce. Managing diversified workforce is a trend in todays' human resource practices at the hotel industry. Workforce diversity is a vast concept and cultural diversity is one of the major aspects within that. Building strong relationships among culturally diverse people lead to generate number of positive outcomes for both the employees and the organization. This study focuses on intercultural workplace relationships in the perspective of Sri Lankan hotel industry employees. The main purpose of the study is to investigate the intercultural workplace relationships among local employees and foreign employees and impact of that relationship on employees' wider attitudes, affective commitment, and fair treatment at work. Researcher tested the applicability of Contact Hypothesis Theory in Sri Lankan context with respect to the hotel industry, to develop and manage intercultural workplace relationships. Employees in five star hotels in Southern Province are identified as the population of the study. By using convenient sampling technique, 161 employees are selected as the sample and a self-administered questionnaire was fielded to collect primary data. Structural Equation Modeling approach was used to test the proposed theoretical model with the help of SmartPLS3. The results of the study confirmed that prior attitudes has an impact on intercultural workplace relationships and intercultural workplace relationships influenced on employees' attitudes, affective commitment and fair treatment at workplace. Findings of the study support the human resource managers to establish proper relationships among culturally diverse workforce and manage them effectively. Further, this study guides the applicability of Contact Theory to manage intercultural workplace relationships within hotel industry employees.

Keywords: Intercultural workplace relationship, Contact hypothesis theory, Affective commitment, Fair treatment, Prior attitudes, Hotel employees

The Negative Effect of Perceived HRM Practices on Work Family Balance of Female Employees' (With Special Reference to Five Star Hotels in Colombo District)

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HRM practices are a set of activities to guidance and operate human capital in the work place and work family balance is a method of balancing personal and professional lives. Hotel industry is providing a wide verity of service and amenities for their focused clientele. However, in hotel industry failed to provide initiatives and facilitation to balance work and family, when concerning about the HRM practices. Specially in female employees'. HRM practices can be influenced to the employees positively as well as the negatively and it will be affected to create high turnover culture in hotel industry. Due to concerning about this consequences, the purpose of this research was to find the negative effect of perceived HRM practices on work family balance of female employees' in five star hotels in Colombo district. Identified negative effects can be raised on work family balance via HRM practices which are negatively affecting the work family balance of female employees'. This study has been based on conceptual indicator model built up using by literature review and final conceptual indicator model developed by referring to the research objectives. Qualitative research was conducted through semi structured interviews under convenience sampling method by using 30 operational level female employees in five star hotels in Colombo district. Thematic analysis explored the nature of work, work schedule inflexibility and lack of quality of supervision as negatively effects on work family balance. The study concluded that, the majority (90%) of respondents' the work family imbalance is existing and there were negative influences on work family balance of female employees'. This study provide work family policies and effective training and counseling as recommendations for employees' perspective to increase their work family balance and management perspective to enhance overall employees' perception regarding their current job.

Keywords: Perceived HRM practices, Work family balance, Female employees, Five star hotels

Event Managers' Perception on Event Risk Management

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The event sector of tourism industry is young, dynamic, growing and maturing at a rapid rate. Every part of event management has potential risks. A good risk management strategy will also cover any other operational areas that are crucial to the event and that may need special security and safety precautions as access control, ticket sales and other cash points and communications. It is unfortunate that the event manager's profession currently still lacks the standardization tools and procedures necessarily need for the provision of empirical data that would enable event stakeholders to make informed decisions (Goldblatt, 2002). Hence, the purpose of the study was to identify the concept of risk of the event managers, to investigate the perceptions of event managers towards risk management and to identify the risk management characteristics. This research is adopting qualitative methodology underpinned by phenomenology research approach. Primary data collected by the author from 16 informants out of 28 from event management practitioners within the whole different range of event management organizations in Sri Lanka who have the membership of Sri Lanka Association of Professional Conference, Exhibition and Event Organizers. And also, semi structured interviews using the quota sampling technique in Colombo district is the main data source and thematic data analysis technique was employed in analyzing the data. The findings reflect the importance of identifying risk for the success of the event and the factors influencing risk perceptions of event managers in the event industry. Further, identified 08 major risk factors as financial risk, technical risk, risk of cancellation the event, weather risk, miscommunication, people attitudes, safety risk and risk of food and beverage in the event industry. Relationship between education and experience with risk perception is also discovered through this research as very influential for the individual's perception. Future research are suggested in the areas of cultural influence on risk perception, risk perception related to various event types (festivals, sports, mega-events, etc.), and risk management strategies utilized by event planners.

Keywords: Event industry, Event management, Risk, Risk management, Risk perception

An Empirical Overview of Contemporary Revenue Management Practices in Hotel Industry; Evidence from Star Graded Hotels in Colombo District

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Revenue Management is an integrated systematic approach widely accepted in the global hotel industry to achieve optimum revenue of service organizations through the manipulation of various strategies. Based on the industry specific characteristics, location, and availability of resources the applications of revenue management in different setups are profoundly varied. The solicitation of revenue management has more strategic and technologically driven practice and hence selecting a most appropriate display for the hotel revenue management in competitive business environment is controverted over the years. This study was conducted to understand and critically evaluate the revenue management practices and techniques, comparative to the hotel demographics and use of pricing and non-pricing revenue management tools in star graded hotels in Sri Lanka to deliver an overview of the application of this global concept in the local context. A self-administered questionnaire consisted with seven sections was distributed among the top managers responsible for revenue decisions of each star graded hotel in Colombo district and collected responses from 45 hotels. Descriptive statistics was used to identify the level of application of diverse practices while ANOVA was used to identify the differences. The results were congregated the demographic data about the sample, various revenue-generating services in in each hotels, revenue management tools applied at the hotel, revenue management team, RM software and distribution channel management, revenue management process, level of knowledge and application of different metrics and forecasting methods used for revenue management. The findings of the study provide ample indications for policy makers and hoteliers to intensify the importance of different revenue management tools and techniques in the hotel industry to meet the expected revenue hallucinations.

Keywords: Hotel, Revenue management, Star graded, Sri Lanka

The Study on Impact of Negative Online Reviews on Hotel Image in All Inclusive Hotels with Special Reference to Riu Hotel Ahungalla

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The hospitality sector has become the major sub sector of the tourism industry which is growing rapidly at present in the global context. At present, due to the digital transformation online customer reviews have become the most important information source in guests' decision-making in Hospitality industry. This study investigated the impact of negative online reviews on hotel image with special reference to Riu hotel in Ahungalla. In this research, the researcher followed qualitative research design and used secondary data through social media such as Trip advisor, Booking.com and Facebook page to collect data. Qualitative data have analysed through content analysis and thematic analysis using Microsoft Excel software. By using thematic analysis method, main themes were identified such as service, staff, price, loss reputation, destruction of trustworthiness, bad image of hotel's service quality, decrease the brand value etc. Poor service, untrained employees, loss of trust, higher price were mainly found reasons for negative online reviews. According to the analysis, the negative online reviews were having a major impact on the hotel image negatively. Hence, the study recommend that hotel management should make efforts to improve the vibe of the property by improving the inner decorations, promoting positive service and provide unique service to give value to the price, and having professional & friendly employees.

Keywords: Negative online review, Hotel image, Secondary data, Social media, All inclusive hotels

The Impact of Gamification Techniques on Employee Productivity in Hospitality Industry: Special Reference to Four and Five Star Hotels in Colombo District

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Although gamification is a modern concept that can be applied in any industry, the hospitality industry is not much applying these techniques to the operations. On-the-job training is one of the most effective types of training which directs to employee productivity in the organization. The main objective of this study is to identify the relationship between gamification techniques used in the hospitality industry to improve employee productivity through on-the-job training. In addition, the paper examines the mediatory impact of on-the-job training on gamification techniques and employee productivity by analysing the collected data from two of the main stakeholders in the hospitality industry: hotel employees and employers. One hundred and fifty operational level employees and fifty executive-level managers who are working at above four-star hotels in Colombo district were selected using convenient sampling technique and two self-administered questionnaires were fielded to collect primary data from selected samples. Six underlying factors were analysed under gamification techniques used in hotels: achievements; collecting; challenge; competition; cooperation; and rules. Based on the analysed data collected from two parties, gamification can be used to act as an interface between employees and hotels, to leverage responsible and ethical working behaviour. Apart from the employee productivity gamification techniques positively contribute on effective communication, social interaction, better informed and more skilled personnel, increased job satisfaction, strategic thinking, positive attitudes toward the employment and lead to a satisfied client. Together with better-qualified employees, gamification contributes to improving the overall image of the hotel, a development of the cooperation between employees and hotels that can have a positive impact on the well-being of the entire hospitality industry.

Keywords: Gamification techniques, Hospitality, On the job training, Employee productivity

Study on Challenges and Success Factors of Independent Restaurants (With Special Reference to Colombo District)

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Hotels and restaurants are playing a major role in Sri Lankan economy. Today, many tourists are used to get their foods from outside the hotel which they are accommodating, also many Sri Lankans are visiting to the restaurants for their meals. Because there is a huge demand for the restaurants there is a high number of restaurants which are newly entering to the industry. But at the same time there is a high number of restaurants which are closing at their first three years of operation. The research study is based on main two objectives, to identify the factors contribute to the success of independent restaurants when most of the restaurateurs fail to be success and to identify the challenges face by independent restaurants. The study mainly depends on the qualitative analytical methods. Direct in – depth interviews with the restaurateurs used to collect the primary data. The population of the research study is Independent restaurants in Colombo district, and according to population 20 success restaurateurs taken as the sample by convenience sampling method. Under a phenomenological research design, thematic analysis used in order to achieve the objective of this research. Through the analysis the researcher identified that dedication of the owner and the dedication of the employees are directly influencing on the success of the restaurant. The combination of education and experience playing a vital role, and the innovations. Most importantly the restaurateurs have mentioned that the better relationship with the employees is an essential factor. Because the employees are the image taker of the restaurant to the guest he should be satisfied about the restaurant and he should be a loyal person. Other than that quality service and uniqueness of the restaurant keep the restaurant in the field, sometime the standards of the restaurant.

Keywords: Independent restaurants, Success factors, Challenges, Restaurateurs

Effect of Customer Relationship Marketing Practices on Customer Loyalty (With Special Reference to Five Star Hotels in Colombo District)

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Customer Relationship Marketing (CRM) is a widely using strategy in the modern-day business arena that allows to cultivate durable relationships with both present and potential customers while helping streamline corporate performance. Theoretically it develops a strong customer relationship, customer loyalty and brand value for an establishment. Service businesses are extensively led to the CRM practices evidently. The objectives of this study was to recognize the different CRM practices that are used in the hotel industry and assess the impact of those practices on the customer loyalty. Total of one hundred guests from five star hotels in Colombo district were selected conveniently as the study sample. A structured questionnaire was distributed to collect primary data and descriptive statistics, correlation analysis, and multiple linear regression analysis were used in the study in order to achieve the research objectives. The empirical results of the study revealed that the five star hotels are using an extensive set of CRM practices aligning to the trust, commitment, social bonding, empathy and communication where those have been felt mostly to the guests. CRM practices of the five star hotels and customer loyalty have a strong positive relationship. The most influential factor among all the customer relationship marketing practices, can be identified as social boding and trust had been identified as the least influential factor which affect to the customer loyalty in five star hotels in Colombo district. The findings suggest that hotels can create loyal customers by exhibiting trustworthy behaviors, communicating information to customers efficiently and accurately, delivering a quality services and improving overall customer relationship quality.

Keywords: Customer relationship, Marketing practices, Customer loyalty, Five star hotels

The Effect of Stress on Job Performance of Frontline Employees of Hotels: Reference to Star Class Hotels in North Central Province, Sri Lanka

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Employees in the Sri Lankan hotel sector are increasingly exhibiting high levels of job stress due to many reasons and this has in turn affected their overall performance at work. There has been some research on stress in the industry in Sri Lanka and elsewhere. Still the amount is not proportionate to the severity of the issue. This paper examined the effect of stress on job performance of frontline employees of Sri Lankan hotel context. 70 self-administered questionnaires duly completed by frontline employees of star class hotels in North Central Province in Sri Lanka were used for the purpose with a response rate of 70%. Descriptive and inferential statistical tools were employed in this empirical study. The findings revealed that there is a high level of workload and role ambiguity existing among the frontline employees of hotels located in North Central Province, Sri Lanka. The existing high level of role ambiguity significantly reduce the job performance of the frontline employees of star class hotels while the existing low level of physical work environment leads to a low level of job performance. To address high existing level of workload, it was recommended that work should be delegated appropriately to ensure that no one is being excessively burdened. Management needs to take remedial action immediately to reduce role ambiguity by providing job descriptions and clear, planned goals and objectives for each job. The condition of the physical work environment is also needed to be improved by reacting quickly to safety concerns.

Keywords: Front line employees, Hotel, Job stress, Job performance, Sri Lanka

Wow Feeling Effect on Repeat Visit Intention: Study on the Heritance Hotel, Ahungalla

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Tourism industry is the largest service oriented industry in the world. Repeat visitation is derived from customer satisfaction which is an essential element for survival of the tourism industry. Identification of most valued attributes are fundamental to attract and retain satisfied customers. Wow feeling has identified as the most important factor that can be increased the tourists' satisfaction. Accordingly, this study focuses to identify the areas where can be generated wow feeling at the hotel and further it develops to identify the relationship between wow feeling and the repeat visit intention of tourists. To conduct this study, it was selected the "Heritance Hotel" in Ahungalla. The repeat guests visited the hotel during the period of month of month of November 2017 to February 2018 were considered as the population of the study. Out of the total repeat tourists visited the hotel during the prescribed period; it was selected 200 tourists to the sample following the purposive sampling technique. Self-structured questionnaire was used to collect primary data. Quantitative research method was applied and correlation and regression values are calculated to analyze data using systematic data analyzing software. According to the study findings, it was able to find out that there is a strong positive relationship between wow feeling and repeat visit intention among tourists. Further, the study focuses that welcome, restaurant and bar and cleanliness are highly impact on tourists when generating more wow feeling at the hotel. Finally, the study recommended that the hotel is needed to be taken actions to develop and enhance the customer loyalty and their satisfaction to ensure the repeat visitations. Hotel management needs to take future actions in their corporate plans to uplift the conditions of the hotel and they need to develop sustainable strategic plan for the hotel while satisfying their customers in their maximum.

Keywords: Wow feeling effect, Repeat visit intention, Customer satisfaction

The Impact of Physical Environmental Attributes of an Eco-Hotel on Guest Loyalty with Special Reference to Eco Lodges in Dambulla

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Sri Lankan tourism sector has been identified as one of the key sectors propelling the country's economic growth. The ultimate goal of the tourism is to gain more & more income and profits to the country and provide high contribution to the GDP. The nature based tourism is an emerging trend in the present global context. Therefore, the demand for Eco and nature based accommodations is increasing rapidly. In this respect, this study attempted to explore the impact of Physical Environmental Attributes of an Eco Hotel/Lodge on Guest Loyalty with Special reference to Eco Lodges in Dambulla. Research questions developed as to find out the existing Physical Environmental Attributes of an Eco Hotel and what is the impact of Physical Environmental Attributes on Guest Loyalty. To answer the research questions, objectives has been developed as to identify the existing Physical Environmental Attributes of an Eco Hotel and to identify the impact of Physical Environmental Attributes on Guest Loyalty. Research is mostly based on primary data and researcher used judgmental sampling technique for the study. Data was collected from 200 guests visit to Eco Lodges in Dambulla by using Structured Questionnaire. In order to achieve the objectives researcher used Descriptive analysis and Multiple Linear Regression Analysis. According to the analysis, there is a significant impact on Guest Loyalty by the Physical Environmental Attributes of an Eco Hotel. Finally, it is recommended that if the Physical Environmental Attributes can be developed and maintained in a creative and innovative manner, the customer attraction and Loyalty will be increased.

Keywords: Eco hotel, Eco lodge, Physical environmental attributes, Guest loyalty

Innovative Technological Amenities in Hotel Industry and its' Impact on Hotel Operational Performance

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The tourism and technology industries are accelerate augmentation industry. Hotel industry adapt innovation technology to become augmentation industry. Past few year researches focus on innovation with the different industries. However, service innovation researches are lacking rather than product innovation researches. And hotel performance research lacking rather than guest satisfaction. So there is empirical gap in the local context, in order to conduct the study, researcher set primary research objective to identify impact of innovation technological amenities on the operational performance of hotels. To achieve this research objective researcher sets three secondary objectives to identify existing level of innovation technological amenities in the hotel industry, identify the relationship between innovation technology and the hotel operational performance and identify the impact of innovation technological amenities and the operational performance. This study based on primary data and research used convenience sampling technique to select the sample to collect data. Data collected from 60 hotels in Galle district by using structured questionnaire. In order to achieve the objectives researcher used descriptive analysis, correlation of coefficient and multiple regression. First conducting the pilot survey finds the existing innovation technologies in the industry. According to pilot survey conducting this research, it found there are significant impact and the strong positive relationship between innovation and operational performance of hotels. The result of the study could give some direction for hotels managers to increase their hotel operational performance by using innovation technological amenities. Innovation technological amenities are derives competitive advantage, generating profit for the hotels, increase effective sales and marketing procedure, effective communication and increase the sustainability.

Keywords: Innovation technological amenities, Operational performance, Competitive advantage.

The Study on Green Event Management Practices to Initiate Sustainable Business Growth in Sri Lanka; Event Managers' Perception

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The growth of the festival and event tourism sector has been spectacular in recent years and thus, event management has become increasingly popular with it growing and expanding equally as much as event tourism. Further, with its exponential growth, there is a criticism for making a large contribution to environmental pollution. Therefore, many international companies are making event greening a part of their tender process. Hence, the objectives of the study was to identify the current green event management practices, to identify the current issues and barriers encompass the management and staging of a green event and to examine the practices to improve the green event management to initiate sustainable business growth in Sri Lanka. Primary data collected by the author from 15 event managers out of 28 from event management practitioners within the whole different range of event management organizations in Sri Lanka who have the membership of Sri Lanka Association of Professional Conference, Exhibition and Event Organizers. Structured interviewed using the convenient sampling technique in Colombo district is the main source of data. Qualitative data analytical method was employed and thematic analysis was used in analyzing the data. The findings of the study revealed that, waste management, energy efficiency, and bio diversity as the parental themes to identify the current green practices which the companies have been practiced and technology, cost, customer mentality, government support, and lack of infrastructure facilities as current issues and barriers of implementing green events in Sri Lanka. They struggled in implementing fully green events while achieving the sustainable business growth. Further, green events can be used by event organizers as a tool for gaining competitive advantages and maximization of the company reputation which are affected to initiate sustainable business growth.

Keywords: Green event, Green practices, Sustainability, Business growth, Event managers

Impacts of Service Quality Dimensions on Home Stay Tourists' Satisfaction: Empirical Evidence from Kandy Area

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Sri Lankan economy has a maximum contribution from service industries and tourism remains in the third place of foreign income sources. Tourism is growing continuously and tourist satisfaction has been identified as a key performance indicator in tourism industry. This research aimed on the service quality dimensions of home stay unit tourist satisfaction with special reference to the Kandy region. Service Quality dimensions are the independent variable and under that there were five sub independent variables. Tourist Satisfaction was the dependent variable and below that there were two sub dependent variables. There were mainly two objectives as to identify the relationship between service quality and tourist satisfaction in home stay units and to identify potentials for improvements in service quality in home stay units. A sample of 150 tourists was drawn using convenience sampling method. Primary data were collected by using self-administrated questionnaire and questionnaire comprised of 34 questions from five sub dependent variables. Data were collected through questionnaire filled by respondents and analysed by using SPSS version 22. Descriptive statistics and correlation were used to analyse the data to achieve objectives of the study. Finding revealed that there is a strong positive relationship with Service Quality dimensions and Tourist Satisfaction. Further tourists were almost satisfied with the existing level of service quality and Reliability get the first place. Same time, Responsiveness take second place and lack of standard level of visually appealing facilities, inadequate equipment and capacity, low level clean environment were not reaching to fulfill tourists' expectations. Therefore, researchers recommended improving the tangibility, assurance and empathy dimensions of service quality effective manner, implement and publish the new policies among home stay units to increase tourists' satisfaction and their revisiting levels.

Keywords: Service quality dimensions, Tourist satisfaction, Home stay units, Tourism

Impact of Guests' Attitude on Green Practices on Boutique Hotel Selection with Special Reference to Galle District

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Travel and tourism industry has a strong commitment on sustainable operations due to the growing demand from the market. Especially, accommodation sector is more profound on the sustainable practices and has a huge conceive on green practices in the operation. Currently, the boutique hotels are prominently adopting green practices in their operation and make a huge investment on this effort. Hence, this research was conducted to identify the impact of guests' attitude on green practices, when they select a hotel to stay during their travel. The objectives of this research are to identify the profile of the tourists who accommodate at boutique hotels, to identify the relationship and impact of guests' attitude on green practices on boutique hotel selection. A sample of 148 foreign tourists who accommodated in boutique hotels in Galle district were selected using convenient sampling and a structured questionnaire was occupied for primary data collection. In order to achieve the objectives, the researcher conducted descriptive analysis, correlation analysis and multiple regression analysis. Findings indicated that green attitudes of guests on green practices significantly associated with the boutique hotel selection. According to the regression result, level of responsibility of Business Corporation was the most influential dimension on boutique hotel selection. It implies that guests' who have the attitude of "level of responsibility of business corporations" are mostly visiting boutique hotels, spread positive word of mouth and willing to pay premium for the green practices. It can be recommended that hoteliers can inform customers through websites, social media and travel agents about their green practices. Further, researcher recommends that hoteliers should develop effective strategies to promote their hotel image, increase retention period and revisit intention by using eco-friendly concepts.

Keywords: Green practices, Boutique hotels, Sustainability

An Analysis of the Push and Pull Motives for Choosing Sri Lanka as the Wedding Tourism Destination: With Special Reference to Southern Province

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Events are becoming established as an integral and major part of tourism development and marketing strategies. Event tourism could be used to describe this phenomenon and this could be defined as the systematic development, planning, marketing and holding of events as tourist attractions. Wedding tourism has increased popularity over the past decade and is recognized as a significant market segment with a possibility of enhancing effectiveness of the industry by amalgamating two segments as one destination. Tourism motivations are important factors in understanding tourist behaviour in relation to selecting the destinations' choice, especially for the wedding market. This is already existing niche market which has not been yet capitalized and can be developed as a diversified tourism product and the effects of seasonality can be minimized. Hence, the purpose of the study was to determine the various travel motivations of wedding tourists to Sri Lanka. The primary data collected by the author from 200 foreign tourists applying convenience sampling technique in Southern province. Quantitative data analytical method was employed in analysing the data using Descriptive statistics. The findings reflect that wedding tourists are primarily attracted by the destinations' attributes such as the famous "sun, sea and sand" which forms part of the characteristics of small tropical islands, followed by other pull attributes. Further, push factors like destination marketing and promotion encouraged tourists to celebrate their wedding function and honeymoon in Sri Lanka. Increasing marketing efforts can prove to be a powerful mechanism in order to encourage the wedding tourism. Moreover, destination managers should better understand the travel motivations of tourists before developing and marketing product and services.

Keywords: Wedding tourism, Pull factors, Push factors

Identify Guest's Satisfaction on Services Provided by Different Hospitality Establishments–Special Reference to City Hotels and Resorts in Western Province, Sri Lanka

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Base on customer's expectations hospitality businesses can be classified as tourist hotels, supplementary establishments and other establishments. Facilities, products and service of each hotels make unique experience to guests. When guests expecting same experience form all hospitality establishments it will difficult to make guest's satisfaction. The primary objective of this research to recognize customer's satisfaction level on products and service of four main departments, in City hotels and resorts. Products and service of front office, housekeeping, food and beverage, and kitchen departments selected as the factors to identify level of guest's satisfaction. Hundred and fifty guests from three city hotels and hundred and fifty guests from three resorts in western province were selected conveniently as the study sample. A structured questionnaire was distributed to collect primary data and descriptive statistics and correlation analysis were used in the study in order to achieve the research objectives. Findings of the research reviewed that customer's satisfaction on food and beverage, housekeeping and front office department's services has strong positive relationship with the service provider's knowledge and behaviour in resorts than city hotels. Customer satisfaction level on facilities provided by resorts higher than city hotels. Findings revealed that personalized service increase the loyalty of customers in resorts than city hotels and satisfaction level of provided facilities increase the loyalty of customers in city hotels than resorts. City hotel customers expect fast service and resorts customers are expecting unique and deep service from service providers. Identifying the customer's expectation will be reason to reduce customer complains. The service nature of the resorts hotels can use to make satisfy the customers of city hotels, it is sensitive application and should be carefully apply to the city hotels by concerning price, product and time.

Keywords: Guest's satisfaction, City hotels, Resorts, Western province, Sri Lanka

The Impact of Employee Transformative Learning on Their Future Retention "Role of Career Satisfaction" (With special reference to hotel industry in Galle district of Sri Lanka)

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Tourism industry is one of the largest industries in Sri Lanka and it provides so many benefits for employees as well as the country in many ways. Employees' transformative learning is a critical factor to retain the employees when considering about the hotel industry in Sri Lanka. Transformative learning means the employees interpretation of the experience creates meaning, which leads to change in the behavior, mindset and beliefs. In Sri Lankan hotel industry, the employees' duty is in a higher position. And also there are some practices regarding transformative learning within those hotels sector. Therefore, the researcher has focused on this study to understand the impact of transformative learning on employee retention under the mediating role of career satisfaction. The researcher has focused to accomplish four objectives with regards to the problem of this study and hypothesized four basic hypotheses according to those research objectives in order to accomplish them. The population of the study was all middle level employees in hotel sector in Galle District. According to the methodology, the sample of the study was 90 employees and it has been taken from 10 three to five star hotels in Galle District. Moreover, data were gathered from self-administered questionnaires. Furthermore, the researcher has used IBM SPSS software to analyse data and descriptive statistics, correlation coefficient analysis, simple regression, mediation assessment through multiple regression and Sable test were used as data analysis methods. Finally, the researcher found that, transformative learning significantly influences on employee retention. Further, the career satisfaction has been significant and partially mediates the relationship between transformative learning and employee retention.

Keywords: Transformative learning, Employee retention, Career satisfaction

A Study on Purchasing Behaviour of International Tourists on Sri Lankan Foods – with Special Reference on European Tourists to Cultural Triangle

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Sri Lanka is a country which can develop many tourism concepts with existing resources such as adventure, religious, *Ayurveda* tourism etc… Sri Lankan foods one of rich resource which can use to develop gastronomy tourism. According to the records of Sri Lankan Tourism Development Authority, European tourists are the highest number of tourists who visit Sri Lanka. Objectives of this research are to identify push and pull factors of local food purchasing behaviour of European travellers, influence of existing pull factors to European traveller's Sri Lankan food purchasing behaviour and identify the factors to increase European tourists to Sri Lankan restaurants. The analysis mainly depends on the primary data collected by the researcher. 150 European tourists interviewed using stratified random sample technique and convenience sampling technique in *Kandy*, *Anuradhapura* and *Polonnaruwa* areas. Data were collected by distributing questionnaire among European tourists in cultural triangle. Quantitative and qualitative analysis methods employed in data analysis. It addressed push and pull factors and tourists perception on Sri Lankan food purchase. Descriptive analysis and perception analysis methods employed in data analyse. According to the findings of the research there were less influence of push factors on Sri Lankan food purchasing behaviour of European tourists than pull factors. Study identified that European traveller's keen to having all information on Sri Lankan foods and environment should be clean, comfortable and facilitated for European tourists. Supportive services such as air conditions, amenities, service methods should maintain in well conditions. Reasonable price level should be maintain in restaurants over the country. Food safety should be in proper conditions. Food should free from any type of hazards and modern marketing methods should use for attract more European tourists to Sri Lankan restaurants.

Keywords: Sri Lankan foods, European tourists, Cultural triangle

Impact of Hotel Attributes on Hotel Selection of Millennial Tourists with Special Reference to Supplementary Lodging Establishments in Dambulla

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Millennials, also known as the Generation Y are expected to represent 50% of the travel revenue by 2020 in Sri Lanka. The behaviours, perceptions, motives and expectations of these travellers are different compared to other travellers. Accordingly, the hotel selection of Millennials depends on various factors. This study focuses on the impact of hotel attributes on the hotel selection of the millennial tourists with special reference to supplementary lodging establishments in Dambulla UNESCO World Heritage City. According to the previous research statistics on accommodation choice of the millennial tourists in the Sri Lankan context, the supplementary lodging establishments had received a significant density. The study aims to identify profile of millennial tourists who select supplementary lodging establishments, to examine the relationship between hotel attributes and hotel selection of millennial tourists, and to identify the most and least influential hotel attributes that impact on hotel selection of millennial tourists. Primary data for the study was collected through the self-administered questionnaire. A total of 191 millennial tourists who stayed at supplementary lodging establishments in Dambulla were surveyed. Descriptive analysis, Pearson correlation analysis, and multiple regression analysis were used to analyse data. The analysis exposed that there was a positive relationship between all the hotel attributes and hotel selection decision of millennial tourists. Highly influencing factors were price, and the location respectively with a strong positive relationship to the hotel selection of millennial tourists. The least influencing factors were staff service quality and room quality respectively. Based on the results, the researcher recommends for the initiations done towards implementing pricing strategies and location attributes in particular accommodation units, if to influence the demand of the hotel selection of millennial tourists in Sri Lanka.

Keywords: Millennials, Hotel attributes, Supplementary lodging establishments, Tourism

The Factors Affecting Customer Loyalty on Ethnic Restaurants in Sri Lanka; with Special Reference to Colombo District

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The strategic importance of food and beverage in the hospitality sector has made a significant growth in the restaurant industry worldwide. Modern customers are looking for more comprehensive experience within the restaurant beyond food and beverages. Hence, ethnic restaurants have been popularized around the world. However, attracting and retaining loyal customers have become a challenge in the sector due to the growing competition. Hence, this contemporary study was conducted to investigate the factors affecting on customer loyalty in ethnic restaurants in Sri Lanka. The data were collected using questionnaires distributed to the customers who visited selected 10 ethnic restaurants in Colombo district. For each restaurant type, 2 restaurants were selected and from those restaurants 30 guests were selected. The research sample consisted of 281 guests using convenient sampling, Descriptive statistics and structured equation modelling was used for data analysis. Results of the analysis illustrated that the most important factor that impact on customer loyalty was restaurant image. Results of hypothesis showed that restaurant image, price perception and quality of the restaurant had a positive effect on the customer satisfaction and customer trust while customer satisfaction, customer trust had a positive effect on customer loyalty. There was a partial mediation effect between independent variables and dependent variable when customer trust and customer loyalty act as mediator. Based on the results, quality of the restaurant and customer loyalty has the highest indirect effect due to the mediators. Lowest number of factor loading is gain by 'Knowledge of the staff about the menu' (0.38) and educating and training staff will improve it. This study will help to identify the factors that mostly affecting to the customer loyalty in Sri Lanka relevant to ethnic restaurants and to identify about customer attitudes regarding the ethnic restaurants and their preferences.

Keywords: Ethnic restaurant, Restaurant image, Quality of the restaurant, Price perception, Customer trust, Customer satisfaction, Customer loyalty

A Study on Migration Intention of Operational Level Millennial Employees in Hotel Industry; Evidence from Kitchen Department in Three to Five Star Hotels in South Coast

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Hospitality industry, as a service industry, human capital is one of the most significant assets of in the contemporary arena. The human capital brings the stable considerable profits and the long-term management and development. However, there is a growing recognition of international recruitments and international mobility of skilled labour is more popular in the globalized economy. Accordingly, emigration of highly skilled persons has significantly increased over the past decades. Hence, migration of trained professionals has created an acute shortage of professionals in developing and underdeveloped countries and this influence on the industrial sustainability in such economies. Currently, Sri Lanka also severely faces this problem and, especially hotel sector is heavily challenged due to the growing opportunities for skilled labour in the international market. The migration intention of millennial is higher than the old generation. In this respect, this study attempted to explore the migration intention of operational level millennial employees in hotel industry. Primary data collection was done using a structured questionnaire for a sample of 146 millennial employees who work in the kitchen department of three, four and five star hotels located in South coast and convenient sampling technique was utilized. Descriptive statistics, Pearson correlation coefficient analysis, simple linear regression and factor analysis were exploited to achieve research objectives. Migration intention do not necessarily lead to actual migration, but it can be used to forecast the future emigration trends. In this study most of the employees were disagreed with the existing situation in the kitchen department. Hence, the results of the study could give some sort of guidance and directions for hoteliers and the government to retain employees in the organization.

Keywords: Migration intention, Labour turnover, Millennial-employees, Hotel

Attitude Assessment of Tea Tourist and the Service Providers to Promote Tea Tourism (Special Reference to Tea Tourism Establishments in Nuwara-Eliya District)

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Tourism is one of the economic pillars of Sri Lanka as it is Small Island with more attractive destinations. Many aspects of tourism are being developed with the advancements in knowledge in tourism and technology. Tea tourism is one of the niche tourisms which can be a main profit-making sector when it is promoted. This study is conducted to analyse the attitudes of tea tourists and service providers towards the promotion of tea tourism in Nuwara Eliya district and to analyse the impact of tea tourists and service providers in promoting tea tourism. This was done by the questionnaire survey method. For that, 200 of tea tourists and 21 of service providers were selected and requested to fill the questionnaires. Samples were chosen from seven tea tourism establishments in Nuwara Eliya district. Individual descriptive analysis was done to analyse the demographic factors. Results revealed that, there is a significant relationship between the awareness and tourists' satisfactory level of the visit ($p<0.05$), there is a significant relationship between the accessibility and tourists' satisfactory level of the visit ($p<0.05$) and there is a significant relationship between the attraction and tourists' satisfactory level of the visit ($p<0.05$) also there is a moderate positive linear relationship was observed between the awareness and tourists' satisfactory level of the visit according to the Pearson correlation value. Therefore, promoting the parameters under each potentiality: Awareness, Accessibility and attraction can directly increase the satisfactory level of tea tourists, thus increase tea tourist arrivals in Nuwara Eliya district.

Keywords: Tea tourism, Tea tourist, Tourists' attitude, Sri Lanaka

Humanities & Social Science

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Human Rights Perspective and a Special Deliberation for Differently - Abled Persons

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Human rights are essential for the protection and preservation of human life and dignity and for the overall development of human Personality. Certain sections of society are more vulnerable to human rights violations, which require a special deliberation. The differently - abled persons are one of the group whose rights are often violated. The existing frameworks of national and international mechanisms for their protection are generally insufficient for satisfying their needs. There is a remarkable gap between the expectations and rendering of social justice in India, as far as the differently - abled persons are concerned. However, all sorts of supports have been given in terms of policies, but they are far from achieving the real objectives of such policies. Everyone's responsibility has become no one's responsibility. Patronizing those with disability is not enough and one needs to work towards their dignity. Therefore, our objective should be not only to improve the quality of life of the differently - abled citizens, but also to see that they should live life with reasonable comfort and happiness. The protection of human rights of differently - abled persons is therefore an immediate and crucial concern. In this backdrop, this paper focuses on various approaches of different ability with special reference to rights based approach and also render some recommendations so that different ability policy should not remained individualized rather than generalized.

Keywords: Human rights, Policies, Differently - abled persons

Impact of Mentoring on Employee Extrinsic and Intrinsic Career Success; The Role of Career Motivation Climate (With Special Reference to Leading Finance Institutions, Sri Lanka)

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Mentoring is the relationship arises among at least two or more individuals. A senior person serves as a mentor, and a person with less experience serves as a mentee. It involves transformation of individuals' mental status. Career success can be achieved through career motivational climate, which refers to the stimulating nature of work place to achieve individuals' career success. Current researcher identifies a gap in the literature about the impact of mentoring on extrinsic and intrinsic career success through the moderating effect of career motivation climate. Hence, the researcher's attempt is to identify the moderating effect of career motivation climate on enhancing the strength of the relationship between mentoring and career success. Managerial level employees of Sri Lankan finance institutions are identified as the sample of the study. The sample size is 100 employees and a self-administered questionnaire was fielded to collect primary data by using convenient sampling technique. The data were analyzed using descriptive statistics, correlation coefficient analysis, simple regression and multiple regression analysis of SPSS software. The results of the study indicated that there is a positive relationship between mentoring and extrinsic and intrinsic career success and there is a moderating effect of career motivation climate on the relationship between mentoring and intrinsic career success. The findings of the study support to the human resource managers of finance institutions to identify career success, mentoring aspects to achieve career success and the actions to be taken for the development of career motivation climate of the institutions.

Keywords: Mentoring, Extrinsic career success, Intrinsic career success, Career motivation climate, Financial institutions

Gender Influence on Students' Achievement in Mathematics: A Case Study of Undergraduate Students in Uva Wellassa University of Sri Lanka

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Mathematics is the queen of science and the language of nature. On the other hand, mathematics is the anchor that combines all sciences and technologies. Its importance should be clear to any reasonable person. Student performance in mathematics is closely associated with the scientific and technological innovations worldwide. However, there is an assumption that gender has significant influence on learning mathematics. That is, male students perform better than female students. This study was designed to carry out comparative analysis of gender difference on students' achievement in mathematics from 2015 to 2018 in Faculty of Science & Technology, Uva Wellassa University of Sri Lanka (UWU). Data were collected from Examination Division, UWU. The population of the study was eight hundred and sixty (860) male and female students from all the academic years. A sample of one hundred (100) students were randomly selected, fifty (50) male students and fifty (50) female students from each academic year among students with mathematics Grade Point Average. Data were analyzed using two-sample z-test significance of mean difference. The result of this study show that there is no significant difference between the academic performance of male and female students in mathematics in UWU from 2015 to 2018 at 0.05 level significance level. That is, both male and female are of the same quality varies based on individual difference not as a result of gender.

Keywords: Mathematics, Gender, Influence

The Female Athlete Engaged in “Masculine Sports”; A Study of the Depiction of Female Athleticism in Post-Title Ix Western Sports Films.

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Though women did achieve institutional rights to participate in so-called “masculine sports”, with the enactment of the federal law of “Title ix” in 1970s, they were not recognized well as male athletes by the sports authorities, public or media. Despite this marginalization, since 1970’s, women have been increasingly portrayed as great athletes in media including cinema. The purpose of this study was to examine the “Post-Title ix” cinematic portrayals of female athletes engaged in "masculine sports" and to examine whether the portrayals had genuinely catered to the empowerment of female athlete or had reaffirmed the masculine hegemony under a falsified female empowerment. The study was conducted based on secondary data. To construct the theoretical and conceptual framework, Michel Foucault's theory of “Panopticism”, Margret Duncan’s idea of "ambivalence" and Judith Lorber’s argument about media overemphasis of heterosexuality were taken to use. The Post “Title ix” films “She’s The Man (2006) by Andy Fikman, “Bend it like Beckham” (2002) by Gurinder Chadha, “Million Dollar Baby” (2004) and “The Next Karate Kid” (1994) by Clint Eastwood and Christopher Cain were randomly selected. The findings revealed these films to have taken measures to counterbalance the dismantled power hierarchy between patriarchal system and the empowered female athlete, using different strategies such as highlighting the heterosexuality of the female athlete, making her a disciple of a male coach or by reaffirming typical gender stereotypes. The films were celebrations of “masculinity” which used female athletes as tools to glorify patriarchy. Despite the attainment of institutional rights women have hardly gained social sanction to remain in the territory of “masculine sports”.

Keywords: Female athleticism, Masculine sports, Title- ix, Panopticism, Ambivalence

Drought, Migration Patterns and Poverty in Dry Zone of Sri Lanka

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There is no country in the world that is not experiencing first – hand the drastic effects of Climate Change. The interlinked challenges of climate change and sustainable development must be urgently addressed to deliver a stable and secure world to future generations. At present, as a tendency to respond the climatic changes including droughts, there is a growth of migrations based on climatic changes all over the world. The main objective of this research is to study the Socio-economic impacts on women and men in low income families due to drought in dry zone of Sri Lanka. Identifying the gender-based migration patterns and coping strategies that men and women use in their households and researching how the drought has concretized their poverty level are the secondary objectives of the study. Elalla Grama Niladari Division in Hambantota was the study area of this research. To collect primary data in-depth interviews were conducted separately among 40 men and women in low income families (listed from samurdhi program) based on purposive sampling and key sources of secondary data were official documents and representations. The study reveals that, men and women who live in dry zones are more likely to adapt the situation using coping strategies rather than migrating from their own lands during the drought season and drought has increased the vulnerability of the low-income families and it has resulted the families to continue to remain in poverty. However, this cannot be generalized into every individual who caught up with drought and the disaster management policy is sensible on the variations of affects due to the gender roles. This paper will also analyze how we can identify the drought as a gendered experience and the nature of the gendered migration patterns in dry zone of Sri Lanka.

Keywords: Drought, Migration, Gender, Poverty, Vulnerability

Female Related Substance Abuse Treatment and Recovery Services in Sri Lanka; Case Study on Drug Addicted Female Service Users in Recovery; Colombo District

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By today substance abuse is recognized as a crucial problem which creates many serious effects on health and social relationships of human beings. Even though many psychoactive substances are known to be commonly spread among men lately a considerable number of women also found in substance abuse. According to the annual hand book of National Dangerous Drugs Control Board on drug abuse information (2016) a considerable number of women were arrested due to drug related crimes such as drug peddling and transporting. The female drug users are a group who need special attention and effective treatment intervention as they are more vulnerable to social hazards associated with drug addiction. The main objective of this study is to analyze the impact of institutionalized recovery process on drug addicted female service users in contemporary urban Sri Lanka using a sociological and a social work perspective to understand gender specific needs within the drug addiction recovery process. The research field was a drug rehabilitation center and an outreach programme carried out in the Colombo district. This study mainly provides a discussion on drug abuse treatment and recovery services related to female drug users based on ten services users. Case study method and in-depth interview methods were used for data collection. The main argument discussed in this study is that a complicated issue like drug addiction is not merely an individual fault but a result of many social and economic factors. It is vital that treatment and recovery related to women are designed to cater for the special needs of the female service users. Especially stereo type gender responsibilities of women may prevent service users from entering and maintaining the recovery process. Furthermore, the discrimination and the social stigma within the treatment and recovery itself may prevent service users from entering the treatment and recovery. This study also tries to highlight the fact that there is also a need for Psycho-Social approach within the treatment and recovery.

Keywords: Substance, Service user, Psycho-social, Recovery

Ways of Overcoming Gender Stereotype Barriers in the Automobile Sector in Sri Lanka (With Special Reference to the Vehicle Services Sector of Diesel and Motor Engineering PLC)

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This study presents a sociological analysis of employment choices of females relating to the automobile sector through a case study of low female employment in the vehicle services sector of Diesel and Motor Engineering PLC (DIMO). The research problem of the study was focused on why there is a low female employment within the vehicle services sector of DIMO. The objectives of the study were to examine the impact of gender stereotyping on low female employment in the vehicle services sector of DIMO and to examine the steps that can be taken to minimize it. A conceptual framework was developed to understand the relationship between low female employment and gender stereotyping. The sample size was determined as 100 and simple random sampling method was used to select it. Both qualitative and quantitative data was collected through simple observations, questionnaires, semi structured interviews and participant observation. The study analysed how gender stereotyping impacts the employment choices of individuals. It was found that socially, employments are labelled as either "Masculine Jobs" or "Feminine Jobs" based on their nature. It influences the employment choices of individuals creating a "Stereotype Threat" which discourages them from entering into gender labelled jobs. This ideology heavily impacts the female employment in the vehicle services sector of DIMO as this sector is labelled as "Masculine only". Gender stereotyping also shapes the competence of individuals while limiting their real potential. Finally, the study shows changing the perception about the vehicle services sector has a probability of increasing female employment in it. Hence it was concluded that DIMO should take initiatives in situations where it interacts with its potential employees such as career fairs, job advertisements, DIMO's web page, DIMO's social media platforms, internship programs, the DIMO's automobile training school and DIMO's Learning Management System.

Keywords: Competence, Gender perception, Female employee, Gender stereotyping, Stereotype threat

Can Kadawatha be Considered as an Urban Area in Sri Lanka? (A Comparative Study of Kadawatha Township and Kaduwela Municipal Council Area)

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This study focused on an analysis of the potentiality for considering Kadawatha as an emerging urban area in comparison to Kaduwela Municipal area that justifies Kadwatha as a township in Gampaha District. The study attempted to compare urban characteristics of Kadawatha with a similar situation of Kaduwela municipal area. Sri Lanka is slowly urbanizing country. However, according to some criteria, it is evident that Sri Lanka is urbanized more than it is revealed by statistics. With regard to non-conventional criteria of urbanization in Sri Lanka, it is obvious that most of the landscape in the Western Province is urbanized. It indicates by expanding built-up area beyond municipal and urban area boundaries. The sprawling effect is the major driver. Besides, there is rapid growth in urban functions within and as well as outside the urban limits and Kadawatha is not an exception. This study focused on configuring built up area around Kadawatha Township applying spatial analysis techniques and tabular data interpretation methods. Through and intensive field survey, the information about residences; business and other function were enumerated. The related studies revealed three major aspects relevant to this study namely; land use and land cover, population growth, and urban function. Based on these criteria a comparative analysis was done for Kaduwela Municipal area and Kadawatha Township. The study found out the potentiality of Kadawatha to be considered as an emerging urban area in Sri Lanka. This finding has given a recommendation as should have concerned this new situation of Kadawatha when preparing forthcoming urban planes of Sri Lanka.

Keywords: Kadawatha, Kaduwela, Land use, Potentiality, Urban

Impact of Counselling On Employee Retention at Exit Interviews (With Special Reference to the Apparel Industry in Sri Lanka)

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Studying counselling on employee retention among employees has become an important topic. The study examines the impact of counselling during the exit interview on employee retention. In a leading apparel company's labour turnover among employees, especially machine operators, which showed that employee turnover is one of the major problems. This study aims to address the objectives of the study were to identify the counselling practices in Apparel Industries, to identify the relationship of counselling in employee retention in exit interview. In order to achieve those, this study was designed qualitative approach. A sample of 30 employees who have already decided to resign was selected utilizing convenience sampling method representing apparel industries. The qualitative data was collected by conducting semi-structured interviews. The interview transcripts were analysed to identify the patterns using thematic analysis techniques. This study used counselling techniques which include Cognitive Behavioural Therapy & Rational Emotive Behavioural Therapy. Cognitive behavioural therapy was applied for fifteen machine operates at the exist interview and thirteen employees were retained. However, after the counselling sessions, two employees were left the institution. This study proposes to apply Rational Emotional Behavioural Therapy, and modifying dysfunctional thinking and behaviour as Cognitive Behavioural therapy techniques during the exit interview or any appropriate time before the employee leaving in order to retain employees. This study recommended practicing employee counselling by using therapies during the exit interview. Further, which may result in retaining employees. This study came up with factors which impact to retain employees. Results of this study add rich qualitative data to the counselling literature as well as to the other social and managerial implications

Keywords: Counselling, Employee turnover, Employee retention, Cognitive behavioural therapy, Rational Emotive Behavioural Therapy

Learning English as a Second Language in a Digital Environment: A Study of the Effectiveness of Blended Learning

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The present study investigated how effective it would be if blended mode of delivery was incorporated into online mode in teaching English as a Second Language. The study utilized a pre and a post-test to compare students' writing performance after 30-hour teaching session in using correct Tenses and Vocabulary in blended and online modes. Thirty participants belonging to 24 to 40 age group were randomly selected from the 36 students registered for the e-Diploma in Business English course at the Department of English Language Teaching in the University of Colombo in 2018. The experimental group was exposed to blended mode while the control group learned in entirely online mode. Each group had 15 participants. The marks they scored at the pre and post tests were analysed using paired t-tests in SPSS 20.0. The results of the participants in the group of blended mode who learnt English Tenses (Mean = -1.00, SD = 0.53, t = -7.25, p=.000) comparing with that of the online group (Mean = -0.067, SD = 0.25, t=-1.00, p=0.334) showed that the mean score of the former was higher than that of the latter. Similar increase was visible when the learning outcome was compared in relation to learning Vocabulary in the blended group (Mean = -0.80, SD = 0.41, t = -7.48, p=.000) and the online group (Mean = -0.13, SD = 0.51, t=-1.00, p=0.334). The study showed that the knowledge in Tenses and Vocabulary of the participants in the blended group was significantly increased compared to that of the online group. Although the current study is based on a small sample of participants the findings suggest that the blended learning approach can be successfully applied for adult's English learning.

Keywords: Online learning, Blended learning, English, Second language, Adult learners.

An Appraisal of Perception and Preparedness of Higher Education Teachers towards E-Learning Resources and Methodologies

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Education is the backbone for the development of a nation in long-run. The face of teaching and learning process has changed substantially. The web has become one of the channels of learning that opens the door for people around the world to access education for free, or for fewer costs. Students prefer different types of learning vehicles and independent learning. Interactive learning and self-paced learning fosters the learning among the students. For Higher education teachers, the web-enhanced teaching is no longer an add-on feature in teaching but a necessity. It is the bound duty of the teachers to upgrade themselves to the current trends in teaching and to cope up with the changing technology. Unless otherwise the teachers are ready for the evolution, it is always going to be a distant dream for the students to learn the concepts through e-learning. Moreover, it becomes more important for the teachers to be aware of the latest e-learning tools and methodologies to equip themselves to meet the future demands and needs of the students' community. Again, the design and implementation of e-learning methodologies largely depends upon the conceptions and perceptions of the teachers. Unless otherwise they have positive opinion and perception about the e-learning, they will not have the right tendency to design and implement the e-learning process. Hence, a study is required to assess the awareness and perception level of the college teachers towards the e-learning methodologies and tools and also to assess their readiness and obstacles in adopting the e-learning methodologies and tools in teaching-learning process. Hence an empirical study titled "An appraisal of perception and preparedness of higher education teachers towards e-learning resources and methodologies" was carried out. For the study, a questionnaire was sent to all 100 affiliated colleges of Periyar University and data were collected from one respondent (Teacher) from each college. Descriptive statistics were used to analyse the data. Results indicated that the majority teachers (88%) are having eagerness and willingness to adopt the e-learning tools and techniques but lack of facilities, incentives; training and institutional supports are preventing them to actively engage in e-learning methodologies.

Keywords: Perception, E-Learning, E-Learning vehicles, E-Learning methodologies, Higher education teachers

Impact of Work Place Social Support on Managerial Employees' Work Family Conflict of Large Scale Apparel Companies in Sri Lanka

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Employees today are experiencing more difficulties than ever in overcoming Work Family Conflict. Both organizational support theory and conservation of resource theory suggest that Work Place Social Support (WPSS) is a better predictor of Work Family Conflict. Hence this study is focused on the role of Work Place Social Support as an indicator in reducing WFC of managerial employees in Sri Lankan Apparel Industry. Primary data of the study collected from 269 managers under convenient sampling technique with the research objective of investigating the mediating effect of Work to Family Conflict (WFC) on the relationship between WPSS and Family to Work Conflict (FWC). Further study revealed the relationship between WFC and dimensions of WPSS namely Perceived Organizational Support, Perceived Supervisor Work Support and Family Supportive Supervisor behaviour. An adapted Likert scale questionnaire was used to survey on managerial employees who belong to the large scale apparel companies in Sri Lanka. This study employed confirmatory factor analysis, correlation analysis and multiple regression analysis in testing the hypotheses of the study by using SPSS statistical software package. Study provides valuable insights to existing work family literature through investigating a statistically significant and strong impact of WPSS on predicting WFC and FWC. Further study revealed a statistically significant negative relationship between WFC and each dimension of WPSS. Further, it was revealed that WFC is mediating the relationship between WPSS and FWC. Hence study recommend to reduce the WFC as well as FWC through enhancing the quality of WPSS within the organizations. Findings of the Study has implications for employees, organizations, managers, administrative bodies and policy makers who are interested in finding ways to reduce employees' WFC experienced in their work setting.

Keywords: Work to family conflict, Family to work conflict, Perceived Organizational Support, Perceived supervisor work support, Family Supportive Supervisor behaviour.

Integrating Literature into Medical Education

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Medicine has been said to be comprised of both science and art aspects. However, the growing demand in main stream subjects and clinical practicum, reduce students' time for the medical humanities. According to Shapiro et al. (2009) there is an ongoing debate on how medical humanities should be integrated into medical education. Hence, this research aims to address the aforementioned issue and introduce a strategy to bridge medicine and humanities, in the field of medical education. In order to address the above, sessions themed under "Literature and medicine" were conducted at the Faculty of Medicine, University of Kelaniya as one of the Student Selected Components (SSC module). This SSC module is implemented for second year MBBS students. When conducting this SSC module, motion pictures, memoirs and non-fictions were used in classrooms as tools of utilization to improve students' humanity towards others. Eight sessions were conducted for the participants where the motion pictures and non-fiction related to medical humanities were involved. Followed by, classroom discussions were done, based on the above material. After conducting the sessions, this mixed method study implemented questionnaires and interviews as the research instruments to obtain students' feedback. The data was analyzed thematically. The results indicate that the participants preferred exposing to the field of literature, viewing them through the angle of medical humanities. Moreover, as for the outcome of the component, almost all the students had written poems, based on the plot of the motion pictures and the non-fiction. Thus, it is believed that the invention of literature programs in the field of medical humanities will strengthen the social responsibility that should be ingrained in medical education.

Keywords: Literature, Medical education, Medical humanities, Motion pictures, Non-fiction

The Literary-ideological Impact of a Translated Text on a Target Community: Revisiting Pitastharaya (The Outsider) in the Cultural Make-Shift Process in Sri Lanka

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This paper investigates the literary-ideological impact that the novel Pitastharaya (translated to Sinhala from the original French text The Stranger by Somarathna Balasooriya) had on Sri Lankan authors who work in the field of literary writing and translations. Based on the understanding that a source text is written for a source community (Dooley 2005; Torop 2000) whose culture and way of life influence the formation of its literature, it is worthwhile to contextualize the impact that a translated literary text can have on a target community, especially taking into account the global significance of the text The Outsider by Albert Camus in relation to a greater cultural make-shift process that was globally followed by existentialism after the Cold War era. Since translations flourish nations by establishing deep interactions, a profound text such as The Outsider that pioneered to establish a different code of ethics and cultural values challenging the hegemonic bourgeoisie and Victorian worldview as well as that which experimented a narrative technique such as 'Writing Degree Zero' (Barthes 1998) should be investigated paying attention to the cultural make-shift process of the target community. Especially, the impact that the above translation had on the Sri Lankan Buddhist community has to be particularly looked into since even existentialism itself was influenced by Western Buddhism. The leading Sri Lankan authors and critics who write in both Sinhala and English media as well as renowned translators will be interviewed to understand the ideological influence that they received through the translated text while the text analysis intends to investigate the justice that the target text had made to the source text by being authentic, accurate and context conscious. In the meantime, the analysis mainly concentrates on the text The Stranger (English translation) and Pitastharaya (Sinhala translation) to illustrate whether the target text could successfully decode the genuine linguistic integrity, innovativeness, writing degree zero, semiotics as well as different cultural signifiers in the source text.

Keywords: Pitastharaya, Writing degree zero, Impact of a translation, Target text, Source text

A Diachronic Study on the Expansion of the English Lexicon

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English which is claimed to encapsulate a rich vocabulary has been nourishing its lexicon from antiquity to the modern times. This study aimed at conducting a diachronic study on the expansion of the English lexicon in emphasizing how the rags to riches story of English coincides with the enrichment of the English lexicon. To accumulate data for the study, the secondary data collection sources such as research articles, books, and journals were referred and semi-structured interviews were conducted with two senior lecturers in English. It was discovered via a qualitative analysis that the external history of England immensely contributed to widen the English lexicon. In expanding on the external history, the contribution of the first known inhabitants of England, Celtics was merely limited to the names of rivers and places. The Germanic tribes, Anglo Saxons that comprised Angles, Jutes, and Saxons arrived at England to assist Celts against Picts and Scots and the fusion of their dialects gave birth to Old English which was spoken from around the 5th century to the 11th century. The Christianizing of Britain during this period upon the arrival of St. Augustine in 597 BC added a host of Latin words related to religion, education, clothing and household etc. Then, the Age of Vikings contributed many Scandinavian words while the Norman occupation in the Middle English period which was characterized by the use of French contributed about 10,000 French words to the enrichment of English. Later, Shakespeare's works, King James Bible, and the mega events such as industrialization, colonization, and globalization gifted a great deal of new lexemes, borrowings, loan words, and idioms to enrich its vocabulary. In conclusion, English can be identified as a flexible language which absorbs the lexical items to suit the needs for its enrichment, development, and growth.

Keywords: English lexicon, Diachronic, Expansion

Impact of Folk Culture on the Establishment of Collective Consciousness in Sri Lankan Rural Community (With Special Reference to God Dedimunda)

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Culture is a human creation and is regarded as something that is acquired after one's birth. At the same time with the release of human hands, other form of thoughts were also gradually grew with them and since them vertebrae was vertically lifted, his abilities and other requirements also developed vertically. Its other meaning is that his consciousness gradually developed. If so, his culture is based on this consciousness. The consciousness is based on process of sign and this sign process is based on the abstract thoughts of man. It has been built on the basis of mankind's collective labor activities. Since labor is used with some purpose, it is connected with consciousness. At the same time, the basis for creating a cultural man is formed. The collective concept of the culture that emanates from the labor market is collective action. Otherwise a collective consciousness. This collective consciousness is the centerpiece of folk culture. These features are permitted to identify through the person's various activities. These folk culture were bases on a homogeneous and small group. Therefore, the fundamental beliefs and functions are also homogeneous. Social scientists have identified the collective consciousness at the main force that ties the individual to society and common values and common standard are shared within these collective group. This collective consciousness can be clearly seen in the belief of the Sinhalese. Therefore, this study was especially focus on God Dedimunda in Kegalle District. It used interview, questioners and both written and explicated sources to collect data. Through this data, was examined how impact of the folk culture on the establishment of collective consciousness. The study has revealed that the folk culture has greatly affected to the establishing collective consciousness.

Keywords: Folk culture, Collective consciousness, Cultural man, Homogeneous

Health Care Seeking Behaviour of Elders in Sri Lanka: With Special Reference to Vavuniya District

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Contemporary Sri Lanka is rapidly grow up elderly population after the free health care services. Ageing is a natural process which associated with physiological and biological changes. Over 60 years age people are called ageing population in Sri Lanka. It has increased from 6.6% in 1981 to 12.5% in 2012 and expected to rise by 28% in 2050. Post war context create social issues in Vavuniya district where elderly people's healthcare problems were suddenly increased, Nowadays 8,790 elders are in this area. This study based on Vavuniya Ds division, Vavuniya district. Sampling selection was carried through purposive sampling and elders who live with their children and between 60 to 75 years age category as the sample of this study. 40 questionnaires and 10 case study were used as data collection techniques. The main objective of this study to identify the health seeking behavioural patterns of the elderly people and sub objective is to examine the health issues among elders. Results of this study, female elders are more concerned about their health rather than male elders. Male Elders who are living with their wife, enjoy their health care. Single female elderly population directly tell their health problems and seeking the health care for them. Most of the elders go to public hospital, pensioners and income earners go to private hospitals and clinics. Following religious worships and activities are common practice among the elders. Conclusion of the study, Most of them use western medicine also few of them follow Ayurveda, siddha and self-medicines. 60% of them go monthly clinics because of their impairment, illness, weakness and several chronic diseases. Education, income, family support, availability of house hold and food decide the health seeking behaviour of elders. Recommended that the health care and support should be strengthened from government, other organizations and household level working on elderly people to overcome barriers of appropriate health care seeking behaviour.

Keywords: Health, Elders, Behaviour, Medicine, Hospital

The Factors Affecting Parents' Leadership Involvement towards Children' Sports Participation

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This study mainly contributes to the body of knowledge in the field of sport management by identifying the factors affecting to the Parents' Leadership Involvement towards their Children' Sports Participation which is considered one of the driven factor in the continuity of sport. As literature shows, Parents play a crucial role in the development of their children's lifestyle and health behaviour. A considerable amount of researches suggests that parents play an important role in youth sports. However, we are often unaware of what motivations drive the parents' involvement in terms of leadership in the family. This study, it was particularly examined the role of parents' involvement in the children sports, with reference to continuity participants. A semi inductive approach was taken to accomplish the objectives with the sample of 300 children by selecting sports in Colombo District in Sri Lanka judgmentally. Conceptualization of the questionnaire items was done by qualitatively with the experiences of the pilot study. Exploratory Factor Analysis method was used as an analytical tool to extract the factors of Parental Involvement in Children Sports Participation Finally, this study found out five latent factors of the PL in Children Sports Participation in Sri Lanka. They are 01. Spend time together with their child at the competition venue. 02. Parent's satisfaction with their children's performance. 03. Parental pressure. 04. Parental self-motivation. 05. Children's perceived satisfaction with parental influence was found. The cumulative variance explained by the factors derived was 75.25%. Each factor is reliable (α=0.71 & KMO = 0.573) to use for further study in this particular as an empirical survey tool. In the case of policymaking regarding sport continuity of school-age children, these findings can be used to articulate the applicable policies.

Keywords: Parental influence, Children sport, Continuity participation, Parental leadership, Sports participation.

Challenges and Issues of Women with Disabilities through Mass Media Education

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Swami Vivekananda has rightly said, "There is no chance for the welfare of the world unless the condition of women is improved, it is not possible for a bird to fly on only one wing." Therefore, the inclusion of women empowerment is one of the prime goals. Thus, in order to achieve the status of a developed country, India needs to transform its colossal women force into an effective human resource and this is possible only through the empowerment of women through mass media education. This paper discusses the importance on mass media education for Women with disabilities. The major objective of the study is to find out the challenges & issues of women with disabilities. In the present study a sample of 100 women with disabilities in Karaikudi district, Tamil Nadu is taken by adopting random sampling technique. The tool for the data collection was Challenges and issues of women with disabilities (CIWWD) were constructed by the investigator. The findings of the research study reveals that 53% of the women felt Education as the most important Challenges followed by Poverty, Employment, Health & Safety, Professional inequality, Morality & inequality, Participation and access to Decision making & Household inequality. Some of the issues of the women with disabilities identified are lack of education, Gender discrimination, Financial Constraints, Family Responsibility, Social Status, Social representation, Media projection, Sexual harassment, Domestic Violence etc. Mass media are used as channels of mass communication. Mass Media education should be imparted to women with disabilities for national development.

Keywords: Challenges, Issues, Women with disabilities, Mass media education.

Family Responsibilities and Career Progression of Women in Private Business Organizations in Sri Lanka

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At present, organizations believe that women also equally strong enough in terms of knowledge, skills and attitudes to males in performing tasks, duties and responsibilities. As every other employee in the workplace female employees also wish to develop their career due to many reasons. As every other employee in the workplace female employees also wish to develop their career due to many reasons. Literature proves that sue to self-interest, status in the society as well as to acquire high monetary benefits and rewards, women are also like to develop their career. As there are many women in the private sector, to move upward in the career ladder while balancing the family responsibilities and work responsibilities has become a very difficult task due to many reasons. Therefore, in this research study, researcher trying to identify the nature of family responsibilities women in private business organizations have and how it influenced on her career progression. For the study, 30 women in top ten private business organizations were drawn from a population of employees in the private sector in Sri Lanka. Semi structured interviews were used to gather relevant data from the participants. Thematic analysis was used to analysis the data using Microsoft excel 2010. According to the research findings, it can be concluded that women in private business organizations have moderate level of awareness about the career, career progression satisfaction and career progression motivation. Also, through this study it has found out that childcare responsibilities, elder care responsibilities and domestic chore responsibilities of women in private business organizations in Sri Lanka have a negative impact on career progression while spousal support is positively affected to the career progression of the women in private business organizations in Sri Lanka.

Keywords: Women, Career progression, Family responsibilities

Impact of Visual-Spatial Skills for Long Term Memory in Secondary School Students

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The purpose of the present study was to determine the impact of visual-spatial skills for long term memory, to investigate the environmental and cognitive factors that contribute the visual-spatial skills, and to explore whether these factors differ everyone. The simple random method was employed. Students (N = 40) were assessed on their visual-spatial skills and on measures related to visual-spatial skills: intelligence, quantitative reasoning, working memory, and home spatial activity engagement. Teachers were assessed on mental rotation ability. Results originate no difference between boys' and girls' visual-spatial skills at age two. Quantitative reasoning donated the most to girls' visual-spatial skills. The differential predictors have implications for the development and fostering of visual-spatial skills.

Keywords: Visual-spatial skills, Long term memory

War Related Sinhala Cinema and Its Undercurrent Socio Political Implications of Language Contact

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Ever since the release of David Griffith's The Birth of a Nation (1915), which modified the manner in which cinema was till then perceived, cinema has been identified as a powerful method of disseminating different ideologies. Subsequently, the applicability of cinema as an ideological tool has been visible even in the Sri Lankan postwar context, where there was also a trend of war related cinema that consists of several potential aspects that can be academically discussed. As the study adopts a linguistic perspective, attention is paid to bilingual instances in randomly selected war related movies directed by Sri Lankan film directors of Sinhalese origin. With the intention of limiting the scope of the study only two movies: Matha (2012) and Gamini (2011), are selected to qualitatively analyse the elements of language contact with the objective of comprehending the undercurrent Socio Political implications to find the answers to the research question which is how have the Sinhalese film directors delineated the contact of different languages in Sri Lanka, which is fundamentally a multilinguistic country. Thus the study is based on textual analysis, with specific attention to language contact. Therefore, Communication Accommodation Theory (CAT), advocated by Howard Giles, and writings based on CAT will formulate the theoretical framework that facilitates the task of concretising the findings. The study concludes that Sinhalese film directors have treated Sinhala as the dominant language which all ethnicities should adapt, Tamil as being limited to the Tamil and Muslim citizens. However English language has been viewed as an adequate tool of coexistence as it functions as a Link Language where culturally conscious parties encounter each other.

Keywords: Bilingualism, CAT, Language contact, Postwar sinhala cinema

Effectiveness of Creative Thinking among Prospective Teachers in Educational Practices

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Nowadays, Teacher role is very vital role in moulding the future of a country. It is very significant in achieving the objective of education. The creativity is one of the most unique traits in human being, these unique traits that leads to solve their problems in new ways or new ideas. Creativity is highly valued in this modern society. This paper is to study about the new education strategy for an active mode of innovative learning. This paper also reveals about nurturing of creative thinking in education and how does create the classroom situation which is receptive in new ideas. This article will discuss about the various steps and process of creative problem and to encourage the students to acquire knowledge in particular field. The purpose of this research is to build creative thinking skills and creative attitude to student for betterment.

Keywords: Creative thinking, Process in creative thinking & techniques

Tax Composition and Tax Compliance: Sri Lankan Experience

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Tax compliance has been recognized as an important topic related to governments' tax policies. Tax non-compliance arises mainly due to tax evasion, complexity of the tax policy and weak administration of tax system. In the case of Sri Lanka, tax revenue which consists largely of indirect taxes is the major source of financing the fiscal deficit and the means of meeting needs of other public expenditures. Meanwhile, the data show that tax compliance levels are relatively unsatisfactory. With this background, our study mainly aims at examining the long-run impact of tax composition on tax compliance in Sri Lanka using annual data for the period 1985-2016. The study follows a time series econometric technique employing Vector Error Correction Model (VECM). Empirical findings of our study show that evidence for the presence of long-run impact of tax composition on tax compliance. According to the results, VAT affects positively to the tax compliance implying these two variables move towards the same direction while income tax negatively affects tax compliance. These estimation results imply that current issues and challenges of the fiscal policy in Sri Lanka are mainly stemmed from the narrow tax base and ability to evade the direct taxes imposed on income while inability of tax evasion of indirect taxes imposed on goods and services. However, import duties do not affect the tax compliance because there are proper recording and auditing on import duties. These results pave the way for proper policy directions related to fiscal policy especially improvements of level of tax compliance through adjusting tax composition and proper administration. In order to mitigate the tax evasion and improve the level of tax compliance the government can relies on indirect taxes (VAT) while, taking necessary measures to encourage tax payers to comply with the direct taxes especially through simplifying the tax system, broadening the tax base and imposing tax fines.

Keywords: Fiscal Policy, Tax Compliance, Tax Composition, Vector Error Correction

Effectiveness of School Based Management in Empowering the Leadership of Schools

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School Based Management (SBM) is aimes at empowering the school leadership to take charge of the management more independently by changing the dynamics of school administration from centrally managed model to more decentralized mechanism of independent schools. The objectives of introducing SBM are many: improving good governance, relevance and quality of education, while ensuring equity and community participation. SBM has been implemented for more than over a decade in Sri Lanka, the outcomes of this program at school level have not yet been brought out adequately by researches. This study attempts to find out the influence of the provisions of SBM on the leadership of school. Descriptive statistical approach is used to investigate the research problem. The research design is structured to evaluate the relationship between effectiveness of SBM as independent variable and empowerment of leadership of principals as dependent variable using the statistical techniques of correlational study. Data was collected by stratified random sampling from the population of principals and members of school boards of 20 schools from Tellippalai Education Division, Jaffna. A questionnaire, focus group interviews, and document study were employed for data collection. The provisions of SBM program have rendered the leadership remarkable degree of freedom for managerial process through participatory management. School self-governance facilitated in more than 88% schools and school boards contributed over 62% and government grants aided at 61% to empower the leadership. 25 % of principals view the SBM to be providing excellent facilitation to the overall leadership functions in schools. While 35 % consider it to be moderate and 40 % are of opinion of less than the average level. Almost all principals feel that there is certain level of intervention of central authorities in SBM which affect the impact of SBM in producing the expected benefits in school management. The authority to handle financial and human resources has not been adequately decentralized yet. The school boards are not independent and lack control over the schools. The newly introduced Enhanced Program for School Improvement (EPSI) initiatives must be revised to strengthen the school boards with more authorities to manage resources and involve in administrative decision making.

Keywords: School based management, Participatory management, School development committee, School management team, Enhanced program for school improvement

A Study on the Impact of Work-Life Balance on Upward Career Mobility of Women Employees; with Special Reference to Banking Sector in Eastern Province

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Women's participation in the paid workforce is one of the most significant social changes of the last century. Towards the end of year 2016, the proportion of women in decision making is very low and still there are only around 4.9 per cent of women are representing the managerial positions in Sri Lanka. The emergence and determined survival of women in corporations and organizations depends on their own willingness to confront and fight strong barriers and hurdles that stand their way. A major barrier for women in work is work – life balance as family and society demands more from a woman than a man. The objectives of this study were to investigate the impact of time balance, involvement balance and satisfaction balance on upward career mobility of women employees in banking sector. A sample of 120 women employees from the banking sector was used for gathering data through the survey method. Primary data was collected through a questionnaire. The collected data was analysed using correlation analysis, regression and descriptive analysis methods. The findings of this study support the previous findings on the similar area. Study indicated that there is a strong positive relationship between work-life balance and upward career mobility. Further, encouraging the hiring, retention, and advancement of women by adopting work-life policies such as day-care centres for new mothers and work adjustments hours for new mothers etc. while achieving gender equality in the organisations were suggested as the managerial implications.

Keywords: Work-life balance, Upward career mobility, Retention

Influence of Language on National Reconciliation in Sri Lanka

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Language is a national identity and Sri Lanka is a country with language differences. Proper respect for language, reduces division of society in a population that is genocidal. Ten years have elapsed since the culmination of the three decades of civil war in Sri Lanka. Different governments came to power in the post-civil war era in Sri Lanka and activated the process of national reconciliation. The main objective of this study was to identify how does the languages in Sri Lanka affect the reconciliation mechanism, which started by the Sri Lankan government. Questionnaire and the structured interview process were used to obtain primary data. Previous research and books were used as secondary data. 100 undergraduates from the University of Kelaniya were selected randomly as the sample. The sample represented Sinhala, Tamil and Muslim ethnicities. Statistical Data obtained from the questionnaire were analyzed through simple statistical methods. According to the findings it was found that (1) language is a critical factor that affects the establishment of reconciliation among the nations of post-conflict Sri Lanka; (2) using Sinhala and Tamil equally as official language of Sri Lanka is crucial and (3) it is required to use accurate language when teaching and using Sinhala and Tamil. The study suggests that it is important to provide zonal and national level awareness on the importance of a language to successfully implement reconciliation mechanism.

Keywords: Ethnicity, Language, National reconciliation, Sri Lanka

Job Stressors and Stress Coping Strategies of Teachers of Secondary Classes

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Life is full of hassles and deadlines. In teaching Profession, the teachers are entrusted with various duties and the responsibilities as they have the innate tendency to mould the young ones. In the process of discharging such crucial responsibilities, they may be caught in problems causing stress and strain. Therefore the present research will help the teachers identify their stressors and their coping strategies to nullify the impact of Stress and help them concentrate more on realising their academic responsibilities. Teachers' stress has been viewed as an interactive process which occurs between teachers and their teaching environment that leads to excessive demands being placed on them resulting in physiological and psychological distress (Forlin, 1996).The researcher identified two categories of coping strategies when probed into the literature. One is Problem - Solving Focused strategies whereas second one is Emotion – Focused Coping strategies. Survey Method was used in this research. On computing factor analysis, it was found that the stress coping strategy 'Adapting' is of very high prominence (0.976). It is followed by 'Accepting' (0.540),'Altering'(0.473) and 'Avoiding'(0.401) in the order of their prominence. It was found from the multiple regression analysis done on the total sample that Workload, interference of officers and others and Overall job stress were the significant predictors of Altering: Workload, Non Academic Deployment, Interference of Officers and others and Overall job stress were the significant predictors of Accepting: However none of these stressors predicted the coping strategies Avoiding and Adapting. It is reported in the study that in the case of all the four stress coping strategies Avoiding, Altering, Adapting and Accepting- about 50% to 60% of the teachers of secondary classes make use of these strategies. Therefore it appears to be a good sign, as a good percentage of them are capable of using all these coping strategies to wade off the impact of the job stress.

Keywords: Stress, Stressors, Stress coping strategies, Problem - solving focused strategies, Emotion – focused coping strategies.

The Role of Workplace Counselling in Sri Lanka with Reference to Operational Level Employees in Garment Sector

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In today's dynamic world, there is no any garment which is free of stress. In response to this stress garments have contracted to make counselling services available to their employees. Workplace counselling is a therapy that provides employees with a safe place to discuss any issues that they're struggling with. The aim is to determine the level of effectiveness of workplace counselling in Sri Lanka with reference to operational level employees in garment sector. In order to achieve it, this study was designed using a qualitative approach. A sample of 15 female, 15 male operational level employees, three supervisors and three human resource managers who are already in three leading garment factories by utilizing convenient sampling method. The qualitative data was collected by conducting semi-structured interviews. The interview transcripts were analysed using thematic analysis techniques. This study came up with four parent nodes as client satisfaction, psychological functioning, the meaning of work and work behaviour. The results revealed there is a significant positive impact from workplace counselling to operational level employees. Through this study the garment sector can build mutual understanding with employees and counselling sessions. Taken as a whole, the results of research suggest that counselling is generally effective in alleviating psychological problems, has a significant impact on sickness absence, and has a moderate effect on attitudes to work.

Keywords: Workplace counselling, Operational level employees, Garment sector, Effectiveness

Lost in Translation: Thinking in First Language and Writing in Target Language.

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The role of first language in target language writing is a topic discussed in Teaching English as a Second Language. The objective of this study is to explore how to overcome the problem of direct transfer of first language to target language, paying attention to the meaning of vocabulary using prefixes in writing sentences. The theoretical framework is the morphological awareness, the ability to reflect on and manipulate the morpheme - the smallest unit of meaning in words in developing English vocabulary. This study was conducted as an action research with qualitative and quantitative data. The sample was thirty undergraduates following English medium lectures, with a low proficiency level in English. A questionnaire was administered along with a Pre-test. Pre-test results showed that the undergraduates had a poor knowledge of sentence formation using prefixes. After teaching prefixes they were tested on sentence formation using prefixes and feedback was given. The process was followed five time using different prefixes. A post-test was administered and semi structured interviews were conducted to ascertain their background. The Post test results indicated a significant improvement. Interviews with them revealed they constructed sentences in the first language and word to word translation into the target language, ignoring the grammar rules of the target language. The study discovered the limited vocabulary and insufficient knowledge of grammatical rules and structures hinder formation of grammatically correct meaningful sentences. The findings also indicated that most of the undergraduates did not have the morphological knowledge which helps in analysing words and writing grammatically correct sentences. In conclusion, the findings imply a need to give more emphasis to increase morphological knowledge and meanings of vocabulary as well as teaching the importance of correct translations showing the difference between the SVO order of the first language and the target language spending more time on focusing on the error prone areas.

Keywords: English, First language, Target language, Transfer, Vocabulary

The Influence of Personality Traits in Acquiring Proficiency in English as a Second Language; A study on Management Undergraduates of the Uva Wellassa University.

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Accomplishment in a second language learning and eventual fulfilment in target language can be concomitant with the concept of personality traits. Personality of a learner could influence the overall success in second language learning. Hence the study focused on finding the influence of one's personality trait in acquiring proficiency in English as a second language. Data for this study was collected by taking a random sample of 160 students from second year and third year. Students were initially subjected to a test to figure out their personality trait by using the "Big Five" personality test. Secondly students were given a questionnaire. To measure the students' proficiency in English, their examination results of two semesters were examined. Multiple Linear Regression model and descriptive statistics were used to identify the personality trait which has the most effect in acquiring English proficiency. The results of the study revealed that there is a significant influence of one's personality trait on acquiring the language. Out of the 160 students, averagely they have 30% of the "Conscientiousness" personality, 25% of "Neuroticism" personality, 18% "Extraversion" personality, 15% of "Agreeableness" personality trait and 12% of the "Openness" personality. Hence the results revealed that the students who fell under "Conscientiousness" and "Extraversion" has performed well in acquiring proficiency in English. Thus, the researcher came into a conclusion that there is a significant influence of one's personality trait on acquiring English as a second language.

Keywords: Extrovert, Introvert, Personality, Second language acquisition

Determination of Influential Factors to Predict Household Income and Feasible Loan Amount in Badulla District, Sri Lanka

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As a result of economic decline and expectation of high standard living conditions, majority of Sri Lankans are struggling to fulfil costs of their basic needs. Stability of income and expenditure can be recognized as a good solution for this problem. The study attempts to investigate determinants which are influencing to income and financial assistantship (loan). At the first stage of the study, impact of costs for basic needs is investigated. The analysis required multi-cultural respondents for a successful survey study. Badulla was perfect with given pre requirement since it covers variety of living conditions in a limited extent. A multi-stage random sampling technique was used to select 500 household heads from six divisional secretariats. The selected divisional secretariats are Badulla, Passara, Uva-Paranagama, Haldummulla, Soranathota and Meegahakivula. Primary data was collected through interview with the use of semi structured questionnaire. Data analysis was accomplished using descriptive statistics, confidence interval, one-way ANOVA and multiple regressions. Results of one-way ANOVA imply that living area can effect on costs for basic needs. Multiple regression analysis showed that total income can be predicted by cost for foods, transport and clothing (p-value<0.05) with 70.9% model accuracy. Moreover, feasible loan amount can be predicted using cost for electricity, water, education, health and social activities (p-value<0.05) with 87.0% accuracy. These five significant factors can be recognized as major reasons to expect a financial assistantship. Result implies that no existing common determinant which explains both income and loan amount. The government administrative and financial sector can get the benefit of this study.

Keywords: Feasible loan amount, Income, Multiple linear regression

Comparative Study of Modern Scientific and Ayurvedic Approach on Food.

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Food is a basic physical need of individual. Taking a balance food makes individual healthy. Understanding the food will help to take balance food. Ayurvedic teachings says that food can become a medicine or poison according to the situation. It will nourish if individual take the right food which match his/her physical and mental structure and at the right time; If not it will cause bad effects on him/her like a poison. In modern science also there are restrictions on food due to sickness, and tolerance. Purpose of this study is to understand food in modern science and Ayurvedic approach. Documentary study is the method used to data collect and content analysis is used to analyse the data. Modern science and Ayurveda is having two different approach on matter. Modern science is having quantitative approach while Ayurveda is having qualitative approach. Modern science analyse matter with 94 natural elements which categorize according to the content of atom. Ayurveda analyse matter with five great elements which categorize according to the quality of the matter. To analyse food also Ayurveda and modern science using the approaches, which used to analyse matter. Modern science using the chemical analyse to categorise food such as carbohydrates, portions, lipids, vitamins and minerals. Ayurveda analyse food according to 3 humours, 6 tastes, 8 energies, and 20 qualities. Both are having post digestive process analysis. Modern science analyse the chemical digesting process. Ayurveda analyse post digestive effect and special properties of food. Both approaches analyses food in detail. However, modern scientific approach is a sole chemical analysis, it has to be taught to know what it contains. Ayurvedic approach can be described with sensual basis. Therefor Ayrvedice approach is essay to explain.

Keywords: Chemical analysis, 3 humours, 6 tastes, Post digestive process, Sensual basis.

Exploring Self-Efficacy of Undergraduates on Pursuing English as a Second Language

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Being the most popular means of international communication, English has obtained its own value and power where Sri Lanka is not exclusion. Hence, most of the universities offer English as a Second Language (ESL) having the prime objective of equipping students with communication and language skills necessary in future world of work. Thus, it is significant to explore their self-efficacy on pursuing ESL at the tertiary level education. Current study intended to explore undergraduates' self-efficacy on pursuing ESL at the university. To achieve the prime objective of this study, a sample of 100 undergraduates of a state university in Sri Lanka who pursue English as a second language was selected using stratified sampling technique. The primary data were collected implementing a questionnaire survey and interviews focusing on seven criteria. As results revealed, except one, majority of respondents have demonstrated higher level of self-efficacy on all the other six criteria. Among them, the highest number of respondents (96%) has recorded their self-efficacy on having attempts on acquiring difficult contents in ESL. Moreover, in relation with criteria: understanding the content of ESL courses, performing well in ESL tests and entailing in activities conducted in ESL courses, more than 80% of the participants from each have shown their self-efficacy. In contrast, 38% of the respondents have recorded neutral viewpoint on dependency of putting their effort on studying English and acquiring the requisite skills where the self-efficacy was indicated only with one fourth of the participants. When considering the confident of understanding the difficult pedagogical concepts in ESL, only 11% of the respondents have manifested strong self-efficacy. Hence, the results of this study are beneficial in designing activities for effective ESL teaching and learning. In conclusion, effective motivational strategies can be applied to make the teaching and learning process a success.

Keywords: English, Self-efficacy, Tertiary, Undergraduates, Learning

A Case Study of the Critical Thinking Skills Among the University Students in Sri Lanka

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Critical thinking skills are considered one of the most sought-after skills in almost every field such as education, finance, legal profession, research, and management etc. Developing the ability to think independently and rationally about what to do or what to believe in certain situations and formulate ones' own opinions and draw his or her own conclusions have been widely accepted as obviously important. In Sri Lankan context, there is an attitude among many people that the university undergraduates are not very good in critical thinking. Therefore the purpose of this study was to determine the critical thinking skills among the undergraduate students in Uva Wellassa Univerity, Sri Lanka. The population was taken as all university 100 level students who are attached to the Faculty of Management, Faculty of Science and Technology, Faculty of Animal Science and Export Agriculture and Faculty of Technological Studies in 2018. The sample of 60 students was selected as 25 male and 35 female. The form of the California Critical thinking Skills questionnaire and an interview method were used to collect the data from the sample. The data were descriptively analyzed using SPSS 16. The results indicate that the respondents are quite confident in their critical thinking ability but according to the findings, there is a mild score of critical thinking skills in general. The score of Critical thinking skills in female students was higher than male students but that is not significant. Based on the findings it was suggested to increase students' ability in critical thinking, special training courses, programs, and workshops etc. are needed to be introduced and included in the university curriculum.

Keywords: Skills, Critical thinking skills, University students

The Use of Words in the Form of Nonsensical Style Camouflaging Personation in Pseudonymous Writing

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The words or Lexis of a given language are employed in diverse social contexts to bring out their meaning and thus the meaning of any given lexis is context dependent. Accordingly, the word 'Position' pəˈzɪʃ(ə)n which had originated from old French from Latin Position (n-) from Ponere 'to place' of which the current sense of the verb dates back to late Middle English the early 19th century has various connotations given its context dependency. In its outset, the term position has several literal meanings when it is utilized in several contexts. The precise sense of the given term means for general public is a place where someone or something is situated or located. Similarly, it also can mean a particular way in which someone or something is postured or posed whilst the term also reflects a situation especially as it affects one's power to act on the state of affairs. Moreover, it can also mean a person's point of view or attitude towards something or someone as the Board's position on the progress of the University or Vice Chancellor's clarification on the position on funds allocation. As stated, position can also mean something else in the field of business as it may mean the extent to which an investor, dealer, or an speculator has made a commitment in the market by buying or selling securities as in the case of 'investors were covering short positions' tec. In addition to the literal meaning of the given term, it also has its ambiguous and implicative meanings given its use in the deep structure. Thus, this paper attempts to provide a detailed language analysis of a pseudonymous letter addressed to the first citizen of the country in the guise of Students Community of Uva Wellassa University by a group of academicians.

Keywords: Position, Meaning, Context dependency, Word, Connotations

Investigation of the Marketing Structure of the Flower Market: Case Study of the Flower Based Market under Religious Purpose in the Sacred City of Anuradhapura, Sri Lanka

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There are various kind of trades and businesses around the archaeological and religious places, especially the flower-based marketing become a widespread business type. The aim of this study is to find the marketing structure & behaviour of the flower market under religious purpose in Anuradhapura sacred city. Primary data were collected by field observation by surveying 60 of flower businesspersons in the Anuradhapura sacred city of the northcentral province of Sri Lanka & descriptive statistical method was used to analyze the data. There are a number of flower shops, more customers & better business environment around Sri Maha Bodhi and Ruwanweliseya than other sacred places in the Anuradhapura sacred city. There is a huge gap between profit levels; profits are higher in Buddhist festival days due to the higher arrival of pilgrims than other usual days. Entering the flower market is not much easy because most of the florists enter to market by inheritance and by the support of relations who have already been doing flower business. In addition, there are some regulations to enter the market; the municipal council of Anuradhapura has limited flower business stalls in the sacred city. Florists can influence the price as they decide the price due to the consensus of all florist who runs flower business in the sacred city. Hence, the price is always equal in any flower shop in the sacred city at any given time. They change the price of flowers in different seasons; the decided price of a flower is higher in Buddhist festival seasons rather than off-season. Few wholesale suppliers supply flowers to the businesspersons. The main reason to limit the suppliers in the market is the lack of sources because the available sources are leased by few flower suppliers. Thus, based on the existing evidence of the behaviour, the marketing structure of the flower-based market under religious purpose in the sacred city of Anuradhapura characterizes an oligopolistic market.

Keywords: Archaeological sites, Anuradhapura sacred city, Flower based market, Marketing structure, Oligopolistic market

The Nexus between Tourist Receipts, Tourist Arrivals & Economic Growth of Sri Lanka

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The travel and tourism industry is one of the world's largest industry & the direct economic impact of this industry comes from the service related accommodation facilities, transportation, entertainment, attractions etc. Many kinds of literature implied as the service sector is one of the key sectors that promote economic growth in developing nations. Thus, the general objective is to identify the relationship between tourist receipts, tourist arrivals and economic growth of Sri Lanka. Secondary data of gross domestic product (GDP), economic growth rate, tourist arrivals and tourist receipts of Sri Lanka since 1977 to 2016 were extracted from central bank annual reports. Descriptive statistical methods; graphical & trend analysis, Pearson correlation analysis & the Granger Causality test were used to analyse the data. The results of the study identified as there is an increasing trend of GDP, tourist receipts & tourist arrivals of Sri Lanka. According to the trend of GDP, there is a gradual increase from 1977 to 2001 and a sharp increase from 2001 to 2016. When considering the trends of both tourist arrivals and tourist receipts, fluctuated between 1977 and 2009. Then, both are increased sharply from 2009 to 2016 because of the end of the civil war conflict with the ensured security for the foreign tourists inside the country. There is a strong positive relationship between economic growth and the tourism industry; tourist arrivals and tourist receipts. In addition, there is a strong positive relationship between tourist arrivals and tourist receipts. The direction of the relationships or the causal relationships implied as unidirectional relationships; from tourist receipts to economic growth, from tourist arrivals to economic growth & from tourist arrivals to tourist receipts. Thus, it shows a positive impact. Hence, it is essential to promote the features of the tourism industry in order to increase economic growth.

Keywords: Correlation, Economic growth, Granger causality, Tourist arrivals, Tourist receipts

A Study of Factors Affecting for Self-Directed Learning of Management Undergraduates in Sri Lanka

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In the 21st century, the ability to engage in self-directed learning (SDL) considered to be essential for university undergraduates to improve and frequently update their knowledge in modern world. The education system has become facilitator which gives the opportunity to develop student's critical thinking, creative thinking and innovative thoughts which are required in their working environment. The aim of this study was to identify the factors affecting for self-directed learning of university management undergraduates in Sri Lanka. In order to achieve the objective of the research, the study was conducted in qualitative research design. Thirty management undergraduates from five regional universities were selected by using convenience sampling technique. The qualitative data were collected through semi structured interviews. The Thematic analysis technique was utilized for the analysis of interview transcripts with the support of NVivo 8 Qualitative Data Analysis (QDA) software. This qualitative study came up with ten critical factors which effects positively and negatively for self-directed learning of management undergraduates in Sri Lankan Universities. Those critical factors were language, interest to subjects/ topics, accessibility of resources, lecturing style and methods, friends' and others' support, time adequacy, student's perception, student's learning style, prior knowledge, student's future goal. Based on the findings, those factors were affecting to undergraduates for engaging in Self-directed learning or preventing from self-directed learning. The result of this research is a significant source for the education policy makers to change teaching pattern, academic curriculum and create appropriate learning context in the university education system to enhance self-directed learning of the undergraduates. Results of this study provide qualitative data to enhance literature related to factors affecting self-directed learning of the undergraduates.

Keywords: Self-directed learning, Adult learning theory, Management undergraduates, Regional university

The Impact of Citizen Journalism Activity towards the Disaster Situation in Sri Lanka (Especially Regarding Natural Disaster-Floods & Manmade Disasters – Aluthgama & Digana Incidents)

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Citizen journalism is a communal development medium usage. It's one of a journalism that can be strengthening the democracy of a country. The term 'disaster' also has a variety of definitions as "A very bad accident" that causes great damage or loss of life. Disaster is an event, which threatens a large section of a society with major unwanted consequences. People of Sri Lanka had been working as citizen journalists in period of disasters. The mobile phones became the first priority among the communication system recently. They can upload information to the internet through their own web sites and blogs in new media technology. Recently new media has become a method of interconnection, globalization and interaction. In this research methods such as questionnaire, Interviews, Participatory Observation and document analysis which have been used to achieve these objectives. Primary Sources are Books and Internet. Secondary Sources are research reports, statistical reports, journals, etc. Colombo Galle and Kandy are the three districts selected in order of priority based on Citizens journalism In Each district the random number selected is 50. The whole sample is 150. The main questions which addressed in this research is "Does the citizen journalism have an impact towards reporting, analyzing, disaster situation in Sri Lanka." Citizens use this journalism for democratic usage. But it's not suitable for Sri Lanka. It should develop and control too. With all the findings in this research it indicates that the citizen journalism have a positive significant influence towards the disaster situation in Sri Lanka. Also find out people get early warning messages through citizen journalism as well as how to use them to communicate. In addition how they react after receiving warning messages and information. The citizen does have the common sense to create the ideology to get their citizen proprietorship nowadays. So we develop its Methods & Code of ethics. It should include in Sri Lankan school Curriculum.

Keywords: Disaster situation, Citizens journalism, Blogs, Early warnings, School curriculum

Gendered Use of SMS

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Surpassing the traditional methods of communication, novel strategies for communication have come into being with the modern, technological advancement. These methods of correspondence have expanded their impact on both informal and formal communicative contexts, depicting both advantages and disadvantages. Today, the mobile subscriber rate has dramatically increased as a result of its popularity in using it for numerous functions and SMS facility has become a commonly used service by commuters since its introduction in 1990 s. Even though SMS is widely used as a service, irrespective of gender, it is fascinating to observe whether gender has an impact on the function and language usage of the individual users. In analyzing the gendered use of SMSes 500 messages of 50 informants from the Faculty of Arts, University of Colombo are examined, and spontaneously produced 10 SMSes are collected from each of the participant and the main method used to collect SMSes was through informal data collection within the researcher's friend circle. Questionnaires and informal interviews were also used to acquire data and attempts were taken to preserve the anonymity of the informants. Further, it was expected to gain answers for five research questions. It was mainly attempted to identify the availability of differences with regard to the function and language of SMSes shared by males and females and the reasons for them. Moreover, specific attention was given to the investigation into the fact whether males' SMS language can be referred to as a report type of language while the females' language can be referred to as a rapport language in texting. Contrary to the hypothesis that gender has a significant impact on the usage of SMSes, the research findings based on the corpus and the answers derived from questionnaires emphasize a minimum gender difference. It is discovered that gender is only one variable that affects the SMS usage among a number of other social and individual factors. SMS practices of both genders seem to be quite similar and both genders use the mobile frequently to text and the reasons for texting and to whom they text are also similar. Considering these observations, it can be concluded that gender is only one determinant that has an impact on the SMS usage as, individual characteristics and their socio-cultural contexts also seem to have a great impact on their SMS usage. Consequently, further investigations on the impact of individual and socio-cultural factors on SMS usage can be highlighted as insight to further research. Nevertheless, the findings of this research provide an insight to the SMS usage of the modern youth in the urban Sri Lankan context while this research also unravels certain aspects with regard to the SMS usage in the country that are not sufficiently researched.

Keywords: Discourse, Linguistics community, Identity, Gender, Function

A Qualitative Analysis on Distance Education around Tea Estates in Sri Lanka. (Special Reference to Uva Province)

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Education plays a key role in the life of an individual throughout the life journey. Being equipped with essential skills and knowledge improves the personality of an individual which will in return results in the upliftment of the standard of living. This research is with the prime motive to investigate the impact of on the lives of children from the tea estates. As the main source of primary data collection, the data collected from the direct interviews through a set of structured questionnaires covering five estates from the Uva province had been utilized to collect data. The main objective of the research is to identify the factors that hinders the motive of students from tea estates to be educated. The qualitative analysis uses descriptive, as the main analytical technique, in identifying the Impact of Distance Education around tea estates in Sri Lanka. The results of the qualitative analysis indicate that, parents with a reasonable educational background, motivates their children to focus on studies compared to uneducated parents. In general parents employed in tea estates are with a low level of education or uneducated. There is a trend of internal migration of younger generation to city areas as job seekers in order to overcome poverty. Further the percentage of school dropouts are high due to poverty, knowledge on the importance of education is lacking from both the parents and children, poor infrastructure and absence of proper transportation facilities. These findings have shown the significance of education for a better standard of living in achieving that they require proper guidance, motivation and adequate facilities to enhance the commitment of children and to uplift their standard of living by raising their bars on education.

Keywords: Education, Life standards, Uva Province, Poverty, Children

A Sociological Analysis on Effects of Social Institutions towards the Education of Children with Disabilities in Sri Lankan Education System

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Education has become a very important social institution in today's social life. This study aimed the research problem of 'What are the effects of social institutions towards the education of children with disabilities in Sri Lankan education system?' The main research objective is to identify the nature of effects of social institutions towards the education of children with disabilities in Sri Lankan education system. A school which teaches students with disabilities separately, has been selected as research field. Interviews have been conducted with students with disabilities in the school, teachers from the school staff, one parent or a guardian of these students and officers who are responsible for the education of children with disabilities to collect primary data. Education is a field that expands skills, knowledge and personal limitations. But at present, many people have misinterpreted the accurate meaning of education as it's only targeting at passing the examinations. The final outcome is due to the institutionalized hostel education, majority of the students in the field have distanced from their families and losing the motivation for continuing their studies. The charity model aiming the concept of 'Karma' and justify the dissimilarity among people rather than considering social diversity. It is important to pay attention for approaches about rights and social structure rather than welfare and individual approaches. Economic institution in super structure affects to education institution in infrastructure. When providing resources structural political-economic issues influence negatively as Sri Lanka is still a developing country. Even though there is a positive contribution from education to enhance capacities of children with disabilities, they are marginalized and excluded in some instances because of negative impacts which they have to face within those interrelated social institutions.

Keywords: Disability, Education, Exclusion, Marginalization, Social institutions

Policy Support for Teacher Identity in Sri Lanka

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Teacher identity is paramount for educational development but hardly any research is available in Sri Lanka to assess the impact of policy decisions on the enhancement of teacher identity of the Sri Lankan teacher. This research is a preliminary study on the extent of policy support available to the Sri Lankan teacher. An important theoretical framework on which this study is based is that teacher identity can be conceptualized as 'The personal and cultural characteristics and experiences of teacher and that It has to be kept in mind that teachers are diverse men and women with varied experiences that brought them to teaching. They have their own priority needs, desires, and expectations with possible positive and negative implications'. The research question is whether the Sri Lankan teacher has the required policy support and psycho social support for positive teacher identity. The method adopted is a quantitative and qualitative mixed method and the preliminary investigations are based on investigating government policy documents, and websites. The methodology and the techniques used are literature surveys, conceptualization, content analysis and coding. The results indicate that although there are sufficient policy documents to ensure the enhancement of teacher identity, in practice the implementation needs improvement. In conclusion, the educational organizations have a great responsibility to develop favourable mechanisms to enhance teacher identity in Sri Lanka.

Keywords: Teacher identity, Policy, Education, Priority needs, Psycho-social support

Library Science & Information Management

- Bibliometrics, Scientometrics and Webometrics
- Documentation and Preservation
- Integrated Library Management System/Library automation
- Information Literacy, Freedom of Information/ Right to Information
- Marketing of Information
- Open Access /Self – Archiving and Institutional Repositories

A Study on the Assessment of the Use of Bibliographic Data & Library Management Software Koha in Academic Libraries of South India

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Emergence of multi-disciplinary subjects in every domain has brought the situation of information explosion and it has become the challenging task for library professionals in libraries to manage information in effective way. However, the advent of technology has given an opportunity to assist these libraries by implementing software to overcome the situation. This study is an effort to examine and assess the use of bibliographic data and open source library management software i.e. *koha* in academic libraries of south India. The study aims to highlight the importance of library automation to academic libraries and its benefits to library staff and users of the library in different ways by reducing the level of job stress and enhancing library services. A systematic questionnaire was prepared and distributed via an email, different forums and social media groups to academic libraries to collect the data. The study focused to find out the use of *koha* software in five states of South India for managing the digital resources. It was found during study that many libraries have adopted this software and have started using for housekeeping operations in their libraries. Many libraries are fully automated and their collections are searchable through online public access catalog.

Keywords: Library automation, Open source, Koha, Academic libraries

Practical Challenges on Implementation of RFID Technology at Academic Library

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Radio Frequency Identification (RFID) is one of the new Automatic Identification and Data Capture (AIDC) technologies. The technology act as the base in automated data collection, identification and analysis systems worldwide. RFID is one of the advance technologies which proven to be best for theft detection, automatic issue / return of books, reduce the retrieval time of books, reduce the human work load towards stock verification etc. The aim of this paper is to brief about Implementation of RFID technology and its practical challenges faced at Thiagarajar College of Engineering, Madurai. And it is provided few suggestions and solutions for the easy way of implementation.

Keywords: Academic library, RFID, Indian academic libraries.

Scientometric Analysis of Materials Science Research

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The paper provides a bird's view about the Materials Science research in the global level as it is necessity of quantifying the research conducted in the field of Materials Science by applying various Scientometric indices and techniques. The study uses Science Citation Index of ISI Thomson Reuters' Web of Science to collect the data. The scientometric data were collected for fifteen years spanning 2002 to 2016 of top fifteen countries in the field of Materials Science. The findings of the study reveal that the percentage share of material science publications is 5.61% out of total scientific publications of the World; the study indicates that the China identified as productive country in the world with 2,87,736 publications, followed by the USA (2,17,422). There is an exponential growth of publication for the world (R2 = 0.967) in Materials Science field; the Annual Growth Rate (RGR) is highest for Iran (through it ranked fifteenth in terms of publications), i.e. 27.00; Activity Index is more than one for nine countries (Japan – 1.093, Russia – 1.043, France – 1.035, England – 1.031, USA – 1.008, Germany – 1.006, Italy – 1.004, Taiwan – 1.003 and Canada – 1.003) which indicates that the research efforts of these countries correspond to the world's average.It is evident from the study that USA (1.48), England (1.19), Australia (1.14), Germany (1.09) and France (1.07) have more than one PEI which clearly indicates that there is an impact of publications in Materials Science by these countries is more than the research effort devoted during 2002 to 2016. China topped the list with the highest mean value of Relative Comparative Advantage for Publication (RCAP) i.e. 2.23. RCAP value of China, South Korea, Taiwan, India, Iran, Japan, Russia and France are more than one. The data indicate that these countries are specialized in the field of Materials Science.

Keywords: Activity index, Citation analysis, Materials science, Scientometric publication efficiency index

Impact of Social Media Tools in Promoting Library Services in Engineering Colleges in Tamilnadu

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Social media tools play a vital role in every domain especially with Library and information Science. This study analyses the various promotional activities done by using the social media tools in Engineering Colleges with respect to Tamilnadu. The data was obtained by quantitative survey method for the study from the 150 library science professionals working in engineering colleges of Tamilnadu. 150 respondents were actively participated in this survey and resulted that Facebook is the predominant tool used by the library professionals to share the library products and services in the age group of 31-50. Among them 48% of respondents are between the age group of 31 – 40. 18% respondents are under the age group of 41 – 50. 26 % respondents fall under the 20 – 30 age group and 8 % respondents are above 51years. This study revealed that 52% of the respondents prefer to access the library resources through library website. 21 % of the respondents prefer the social networking medium to access the library resources and only 19% prefer to go in person to access the resources. This reveals the increased trend of user's preference to access library resources through online mode. Among the social media 30% respondents prefer Facebook as a knowledge sharing tool, followed by Whatzapp (26%) which is providing speedy information, Twitter (23.3%), LinkedIn, which 13.3 % of respondents have given their preferences. Among the respondent male respondents are using the social media enormously. Tamilnadu has an ample number of engineering institutions especially in the accessing the information products and services, this study analyses the impact of social media in libraries and its extent to promote the activities of library and information centers.

Keyword: Social media tools, Library and Information centers, Engineering Colleges, Tamilnadu

Utilization of E-Resources and Services in the Medical Library of All India Institute of Medical Sciences, Delhi

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The increasing use of electronic resources in changing scenario of Library and information centres, it is essential to connect the library services through the Internet and to access information services from other sources has reduced the capacity to characterize and categories users. The electronic resources have become a very widely used format of choice for academic library patrons. The use of faculty, researchers and students has electronic resources in medical library starting in the opening years of the 21st century. There are so many e-resources are available on Internet like e-journal, e-book, e-database etc. The study was conducted to examine the usage of electronic resources by undergraduate, Postgraduate and Faculty members at All India Institute of Medical Sciences. It also high lights the users' awareness of different types of e-resources available in the B.B Dikshit -Central Library at AIIMS -Delhi. It is perceived that patrons will be in favour of electronic resources management and demand for a simplest most direct path to information irrespective of the methods that are being adopted. Portability, sharing and convenience are increasing important for end users. Libraries need to manage electronic resources effectively to the optimum utilization by overcoming the issues and challenges. Growth of electronic resources even through slower than what is expected will force the libraries to switch over to more and more electronic resources in future. However, with the innovative approaches to solve these issues and with a high degree of emphasis on standardization, the task of managing electronic resources will become less complex in the future. It is the responsibility of the higher educational institutions.

Keywords: E resources, E services, Medical library.

Digital Literacy Among Rural Women: A Study of Selected Districts in India

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In today's world, technology occupies center stage in national as well as international aspect. New technologies are employed for improvement in knowledge generation as well as sharing nowadays. Information and communication technology (ICT) is one of the technologies which is contributing and enhancing nation's growth. The rapid adoption of information and communication technology (ICT) has enabled people to access information across the globe. But there is a widening gap between those with access to these tools and those without the ability or means to access them. In a digitally unequal world, we need to focus on bridging the gap between the digitally privileged and underprivileged community of rural India. This study is carried out to examine the digital awareness and digital literacy among rural women. Digital literacy is the ability to find, evaluate, utilize, share and create content using information technology and the internet. Digital literacy is the knowledge, skills and behaviours used in a broad range of digital devices such as smart phones, tablets, laptops and desktops, all of which are seen as network rather than computing devices. Ramanathapuram and Sivagangai districts were selected for this study. A simple random sampling technique is used for selecting sample. The total sample size is 140 respondents. The finding of the study reveals that 49.28% of the respondents use computer for personal work purpose. Majority of the respondents 34.28% using computer for less than one year. Most of the respondents use mobile for entertainment purpose, followed by educational and information purpose.

Keywords: Digital literacy, Social media, Internet, Computer, Mobile and user study.

Big Data: A Scientometric Analysis Based on Indian Publications

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The present research was carried out with the purpose of evaluating the growth and characteristics of big data research output by India. This study has been assumed with the purpose of examining the literature published on 'Big data' in Web of Science (WOS) database by Indian scientists. WOS covers nearly 20000 + titles from over 3300 publishers, of which supported 256 disciplines. The 'Big Data' was used to search the article indexed in Web of Science for retrieving the results. Total of 714 documents were indexed in web of science from India. The data were exported to MS-Excel where the tabulation and simple statistical methods was applied. All these articles published in 477 journals during the period 2008-2017. From these Journal of Pharmaceutical Biological and Chemical Sciences Research were found to be most productive and preferred by Indian scientists for their scientific communication. A significant note of the study is that the majority of the articles are contributed by multiple authors. In this study single author has contributed 67 (9.38) papers in this study. Two and three authors contributed papers occupying first and second in the order, it is calculated 221 (30.95) and149 (20.87) respectively. Four authors contributing to the research occupies the third rank with 99 (13.87) and single author occupy the fourth rank at 67 (9.38). Five authors and ten+ authors placed fifth and sixth ranks with 63 (8.82), 44 (6.16) respectively. Six authors and seven authors contribute papers got seventh and eighth rank with 29 (4.06), 15 (2.10). Remaining eight authors 12 (1.68), nine authors 9 (1.26) and ten and above authors 6(0.84) contribute papers placed ninth, tenth and eleventh rank respectively. The study also analyzed the year wise distribution, document wise distribution, author wise distribution, and top ranked Institute in the field.

Keywords: Scientometrics, Big data analytics, Web of science, Authorship pattern, Degree of collaboration

A Study on the Usage of Social Networking Sites among Polytechnic College Students in India

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Social Networking sites have become a popular tool for shareing information and knowledge and to express emotions among students. This paper aim to identify behavior pattern of using social networking sites by the students of polytechnic college students in India based on the Level of awareness, frequency, purpose, stratifications of social networking sites etc. A Structured questionnaire were distributed among 300 students who are undergoing the Social Networking sites in Polytechnic college students in India. The snowball method of sampling has been adopted in collecting data. Of which 274 were received. The majority of the respondents use for the social network sites in urban 106 (38.69%), male respondents in 84(36.36%), female respondents in 22(51.16%). semi urban respondents using 75(27.37%), male respondents in 65(28.14%), 10(23.25%) respondents who have semi urban in female. 93(33.94%) respondents have rural, 82(35.50%) respondent for the female locality using social network sites. Majority of the students were responded from the department of electrical and electronic engineering. Among the respondents 93(33.94%) of the students use social networks daily, among these, male respondents 74(32.03%), female 19(44.19%). The paper also suggests that social networking sites have created a phenomenon over the past decade. Electronic communication has altered different way; we interact with one another, organizations, and products. Social media websites are also offer new innovative ways of communicating with other individuals.

Keywords: Social networking, Polytechnic students, Social media

Job Satisfaction Among Public Library Staff in Trincomalee District

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This study investigated the job satisfaction among Public Library staff in Trincomalee district. The satisfaction affects the organization in which a person works and it affects the quality of work provided to the society. Trincomalee district has thirteen divisions. Researcher has selected only the tamil divisions which consist of twenty-five libraries. Due to language barriers five pradesa saba divisions are excluded from the study. Self-administered questionnaire was issued to 89 staff and a structured interview with the librarians and the field visit to all divisions were carried out. This study is based on the population approach. The study has thirteen factors considering the Maslow need theory and Herzberg two factor theories with forty-one statements. Excel sheet and SPSS package were used for analysis. SPSS package 16.0 was used for the analysis. Decision Criteria is if the mean value is 1.5-2.5 Low level of agreement. If mean value is 2.6-3.5 is Moderate level of agreement. If mean value is 3.6-5.0 is High level of agreement. The factors which falls into high level of agreement are responsibility 3.715, pay 4.071, job security 4.363 and work -itself 4.396. Organizational policy 2.734, supervision 2.764 and interpersonal relation3.494 have moderate level of agreement. The factors like growth 1.685, achievement 1.707, advancement 1.734, recognition 2.168 and work condition 2.419 have low level of agreement. The overall satisfaction is 2.932089. It shows that staff are in moderate level of agreement in Trincomalee district. One tailed test was selected to calculate p value since a test of a statistical hypothesis where the region of rejection is on right side of the sampling distribution. The calculation considers only above the mean value and overall standard deviation. The p value for pay 0.0001 is <0.01 , work itself 0.00012<0.01, job security 0.000135<0.01 shows that these factors are extremely significant. Responsibility p value equals 0.0906 by conventional criteria this difference is considered to be not quite statistically significant. These factors contribute to staff job satisfaction. Remaining factors p values are > 0.01 shows that these factors are not statistically significant and not contributing to the library staff satisfaction. Public library administrative body has to pay attention on this to motivate the staff for better performance in future. Ranking method shows the priority order of factors that contribute to public library staff job satisfaction. Public library managing authority should pay their attention on hygiene factors to minimize the dis satisfaction and should pay attention on motivating factors to improve job satisfaction.

Keywords: Job satisfaction, Public library, Library professionals, Trincomalee district, Sri Lanka

Marketing Applications in Kelaniya University Main Library

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The purpose of this case study was to describe marketing methods, techniques and activities used in Kelaniya university Library and their staff perceptions regarding the importance of marketing applications. In addition, it identifies factors which hinder the uptake of marketing, and investigates the evaluation methods used. This study used survey research method. This study selected all Academic staff members in university of Kelaniya library. Data collected through Observation and interviews. Secondary data was also used in this study. The present study examined the current situation in Kelaniya University Library as well as staff attitudes and perceptions towards marketing applications. The findings of the study indicate that Academic staff acknowledge the need to adopt marketing techniques as a means of promoting library services, and they realize that marketing approaches can be effective if they are correctly incorporated into their work. However, the results indicate a divergence in practice. The majority of library made some marketing techniques, mainly related to promotion and advertising, without incorporating the concept of marketing into their general institutional goals and strategic planning. Whilst marketing techniques and methods are used in academic libraries worldwide, the spread of marketing in Kelaniya university library provide to be limited. Basic operational problems were identified as the main barrier to greater uptake.

Keywords: Academic libraries, Library service, Library evaluation, Library marketing

Impact of E-Resources and Information Seeking Behaviour Among Military Students of General Sir John Kotelawala Defence University

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The scope of information seeking consists of three main areas viz; finding information, organizing information and using information. This study examines the user-centered problems in information seeking bahaviour of military officer-students in relation to the usage of e-resources. The overall aim of the study was to analyse the existing trend in information seeking behavior of military students amidst the influence of the e-resources. Three objectives were design to analyse the concept. To reveal the accessibility of internet and use of it for retrieving information, to identify their usage of e-resources for their studies, to find the impact in information seeking behavior due to the e-resources and to recommend the ways to facilitate information seeking behavior to retrieve information for the effective learning. Quantitative research design was employed to determine information needs and information seeking behavior of the students. The military officer-students who follow their studies at Faculty of Graduate Studies of KDU are taken as the study population. The 137 officers consisting tri-forces follow courses. The quantitative data was entered into SPSS and they analyzed. In order to retrieve information, one should have internet accessibility. Based on the survey, it was found that 100% of students have internet facility. Majority of the students have at home. But they have inadequate knowledge of using internet to get proper e-resources for their studies. But they like to use e-resources as it is convenient in learning process. Since they employed officers, they are unable to get frequent assistance from the library to get proper e-resources. Students have to visit to access databases in University premises. It is recommended that library should provide user name and password to get remote access of the databases. In addition, information literacy courses have to be conducted time to time to facilitate them to use e-resources to make their studies effective.

Keywords: Information seeking behaviour, E-resources, Digital documents, Military officer-students

An Implementable Architecture of E-Library Using Cloud Storage System

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In olden days, the user accessed library information system are complicated due to large database appeared in single area. The need for storing the library information system in digital manner by applying cloud computing. The cloud computing resources, services are completely based on ubiquitous computing. As a result, library patrons can access services from outside of physical library by cloud computing. This paper analyses overview of cloud computing, current trends, standards and proposals for e-library with cloud storage system and possible cloud types. This paper also exposes the research reports and views of various researchers on digital library and its services using cloud concepts. The cloud storage is an innovative revelation of Information Technology of digital world. It contributes an original scheme of a cloud storage functional architecture for building e-library systems. The e-library services makes novel trend in scheme of cloud storage data center with respect to information access and dissemination of cloud computing. The cloud storage functional architecture for digital library is an internet based standard communication which maintains the inter-relationship between user and cloud storage providers. It provides information handling, speedy transfer of e-library information and linking of communication with user and cloud storage provider. It will promote the maturity level from clerical to administrative members that meet client request and recognize the sustainable growth of e-library system. This architecture progressively developed e-libraries knowledge management by means of user involvement. This e-library system using cloud storage implementation makes better data integration, reduced cost, accessible any where any time resources, elasticity, scalability and portability.

Keywords: E-library, Cloud computing, Cloud storage, Digital library, Computer network

Analysing the Purpose of Using Social Networking Sites by the Post Grauduate Students and Research Scholars of Alagappa University: A Case Study

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The purpose of the study is to assess the usage level of Social Networking Sites (SNS) by the postgraduate students and research scholars of Alagappa University, Karaikudi. It highlights the user attitude and approaches towards social networking sites of Karaikudi. A questionnaire was distributed among the users to collect desired data. It adopts the methods of questionnaire and convenience random sampling for collecting data from the research scholars and students. Out of 100 forms distributed, the researcher received 84 properly filled questionnaires and used for the data analysis. 17.86% of the respondents belong to the social network sites hours a week; 27.38% of the respondents belong to the purpose of using social network sites; 26.19% of the respondents feelings experience happy excites; 36.90% of the respondents belong to the using Library; 27.38% of the respondents belong to the frequency Mozilla; 21.43% of the respondents using belong to the facebook. In this study, 50% respondents belong to using the e-resource daily; a majority of the 46.43 % respondents belong to the category of Semi Urban, 29.76 % of the respondents belong to the category of Urban, and 23.81% of the respondents belong to the category of Rural and 61.90% respondents belong to the category of Unmarried, 38.10% of the respondents belong to the category of Married.

Keywords: Social network services, Social media website, Academic services.

Publication Productivity of Child Labour in Indian Perspective: A Scientometric Analysis

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This paper attempts to study the performance of child labor in India from 2008 to 2017. Total 251 articles were published during this period. The data was retrieved from the Web of Science and analyzed to know the authorship pattern, degree of collaboration and geographical distribution of papers, year-wise research output, geographical distribution of research output, and nature of collaboration, characteristics of highly productive institution and the channel of communication used by the scientists. Singh A was the most productive author with six records and also the highest global citation of 36. World Development was the most preferred by authors of India for publishing child labour related research as well as the highly cited journal in this field. Out of 251 papers, 248 are published in the English language. USA is the collaboration with India and second position is UK with 37 records. To assess this research productivity, Relative Growth Rate (RGR), doubling time, degree of collaboration and selected research indicators were used. For this study the data is retrieved from Web of Science. Fluctuation are shown in RGR and Doubling time during the study period. The highest publication productivity found in the year 2016.

Keywords: Scientometrics, Mapping, Child labor, India, Publication productivity, India

Output of Marine Biology Research Publication on Science Citation Index Database from 1999-2017- A Scientometric Analysis

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This study explores to identify the research growth on marine biology publications from the period of 1999-2017. Data was collected from the Science Citation Index (SCI-Expanded), Web of Science (WoS). The WoS is the search platform provided by Thomson Reuters. The distribution of publications based on the year of publication, country, language, and document type were studied. The relative growth rate of the publications and doubling time is calculated. This study focused on the bibliometric analysis of research publications in Marine Biology. Data was collected from the Science Citation Index (SCI-Expanded), Web of Science (WoS). The WoS is the search platform provided by Thomson Reuters (the former Thomson Scientific emerged from the Institute for Scientific Information (ISI), Philadelphia). SCI database is one of the very comprehensive databases covering all aspects of science. The records were analyzed using the web of science website application as per the objectives of the study. Microsoft Excel software was also used to analyze the data. A total of 4,290 records were identified and downloaded in the field of Marine Biology worldwide during the period 1999- 2017. The records were analyzed using the web of science website application as per the objectives of the study. Microsoft Excel software was also used to analyze the data. The research output shows a continuous increase during the period of study which reveals that the Marine Biology Research was in steady growth. Most of the publications are published in Journals shows that authors are interested in publishing Journal articles. Most of the researches are done in the English language. The United States of America published more articles in Marine Biology. Most of the favorite research area was Marine Fresh Water Biology. Growth rate and Double time analysis also shows that the higher growth trend in this particular period of study. These findings of the Scientometric study on Marine Biology will be helpful for the Marine Biologists for further research in these areas.

Keywords: Citation analysis, Bibliometrics, Research evaluation, Web of science.

Integrated library Management System (ILMS) using KOHA open source software in India

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"Koha" Integrated library Management System (ILMS) is first open source software in the world, used by more than 80 countries. In India, Koha was first installed by St. Joseph's College, Devagiri, Kerala in the year of 2000. It was considered as a remarkable achievement. Compared to other open source library management systems, Koha is relatively more popular in India due to its active users' community. Now, there have been a number of Koha installations in India and the group of experts in India is growing. The annual conference of Koha developers and users called 'Kohacon' was also held in India recently. It has received much attention in the library management system of India. Purposes of this study are (i) to understand the popularity of Koha among library professionals in India, (ii) to know the level of satisfaction in using Koha open source ILMS software among LIS professionals of India. 150 Questionnaire were distributed and only 95 (64%) received. The study revealed that majority of the LIS professional who were responded 61% are satisfied with Koha and 18% professionals are highly satisfied. Circulation module is the most favorite module of Koha and 64% of professionals have expressed excellence about the performance of this module. However, most of the users 52% are not interested in using serial control. In line with findings, the study recommends to use all modules which are available in Koha open source software in order to simplify the library functions.

Keywords: Open source, Library automation, Library system, Koha

Scientometrics Analysis on Elephants

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This paper labels the scientometric analysis on "Elephants". Publications on "Elephants" for the academic period 2002-2017 is considered for this study and has records of 9160 having h-index of 118 with citations of 1,38,206. 119 countries contributed 9106 publications were distributed in various subject domains. 21,510 authors contributed various articles in reputed journals namely NATURE, PLOS ONE with funding from various international funding agencies. The present study is to investigate the research productivity on "Elephants" scholarly publications. It aims to identify the distribution of research output on the basis of research papers contributed by Scientists. The study examines the prolific authors, country wise distribution and funding agencies during the study period. The author productivity, degree of collaboration was also brought under the purview of the study and it is also analytical in nature with the suitable statistical tools applications in strengthening the experimental validity. There are various sources contributing to the research output on "Elephants" research by overall scientists. For this study the researcher has taken the secondary sources from online database. The necessary data was collected from the database of Science Citation Index (SCI), Social Science Citation Index (SSCI) and Arts & Humanities Citation Index (ACHI) which is available via the Web of Science (WoS). The WoS is the search platform provided by Thomson Reuters (the former Thomson Scientific emerged from the Institute for Scientific Information (ISI) in Philadelphia). SCI and SSCI database is one of the very complete databases covering all aspects of science. The study period 2002 to 2017 is selected in the available database. The researcher has used the search string Elephants in the address field for the study period of 2002 to 2017 and downloaded the records based on the above string. Total of 9160 records were downloaded in the form of Notepad and used the Histcite, and MS Excel packages for tabulation.

Keywords: Highly cited papers, Research funding pattern, H-Index, Citations

An Analytical Study: Resources Development of University Libraries in Tamilnadu

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Library collections are consider in terms of books and serials, which include a range of resources that are both subscribed, purchased, donated and open resources such as manuscripts, archives, photographs, sound recordings, video recordings, microforms and meta documents and so on. Collection not only means a particular collection of different kind of objects but also mixture of text, image, sound animation and artifacts. Resources in simple terms denote as the planned purchase of materials in different formats to meet the curricular and research needs. Collection development is a process which merges potential and occasional user needs and knowledge resources both in conventional and electronic resources requirements. Collection University system entirely differs from other types of libraries. As it has multidimensional nature with the right balancing of focused procurement procedure by meeting all genuine resources needs of potential attitudes as even as the library users across the region. The research aimed at identifying and assessing the process and practices of collection development and present status of library collection, the prevailing library facilities and the resources towards collection management among the University libraries in the State of Tamilnadu. The research design is descriptive and the method is a normative survey, which used questionnaire as data collection tool. The data made descriptive and scientific analysis using chi-square, one way ANOVA, Percentage and so on. The study observe significant gap between the resource development of e-resources and print resources among the surveyed libraries. Almost all the surveyed libraries are procuring different formats of information resources. The study is concluded that the surveyed libraries are using library networks and consortia for resource sharing and access. University libraries and working library professionals, though they are comfort with conventional resources building and collection management methods, training on modern, sophisticated and world class protocols need to be provided to enhance collection management and preservation.

Keywords: Library collection development, Manuscripts, E-Resource Access, Collection, Management

The Effects of Perceived Ease of Use and Perceived Usefulness on the Adoption of Social Networks by Library Professionals in Sri Lanka

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In this digital era emerging technologies such as social networks have produced drastic changes in libraries across the world. It is important that library professionals be in par with new technologies for the long-term sustainability of libraries in this information age. The effective use of social networks will enable libraries to render user-oriented, innovative services to users in their preferred surroundings, breaking the walls of traditional library system. Despite the significant benefits of social networks, the extent to which library professionals are inclined to embrace these social technologies remains unclear. For the successful integration of social networks into libraries, it is crucial to identify the factors influencing library professionals to adopt such technologies. In this study the Technology Acceptance Model which emphasizes the cognitive beliefs of perceived ease of use and perceived usefulness along with user intention of technology use, is applied as a theoretical basis to better understand the adoption of social networks by library professionals. This study followed a quantitative approach, employing the survey strategy to gather data from a sample of 64 library professionals employed in the Sri Lankan university library sector. Data were analyzed by multiple regression techniques. It was revealed that, both perceived usefulness and perceived ease of use were positively related to the intention to use social networks and these two predictors explained 50.7% of the variance in the users' intention. Perceived ease of use also exerted a significant effect on perceived usefulness. The findings suggest that perceptions of ease of use and usefulness are the key drivers of social networks adoption by library professionals in Sri Lanka. This study renders empirical evidence in support of the applicability of the original Technology Acceptance Model into the context of Sri Lanka

Keywords: Social network, Intention, Technology acceptance model, Sri Lanka, Library

An Investigative Study on The Challenges Faced by University Libraries to Establish the Green Library Concept: with Special Reference to The Library of University of Kelaniya

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University of Kelaniya has been functioning as the first green state university in Sri Lanka since 2015. Center for sustainable solutions and Nature club of the university accomplish a national and an international service to the world. On account of these, the library of university of Kelaniya is supposed to extend its contribution in this regard. But such a contribution is not evident. In view of that, the objective of this research was to identify the challenges and barriers faced by this library and suggest the most suitable solutions for those. 5 main fields namely, library building, collection, information systems, practices and programs or services were defined to measure the contribution of the library with regard to the green concept. The primary data was randomly collected from selected 5 academic staff members by conducting interviews and self-observations. The collected data revealed that the library adheres to some green practices such as construction of the new library building as to get the maximum benefit of day light and natural air, acquisition of electronic sources, library automation, waste and electronic disposal management. Although they practice green concept up to some extent, the library cannot be named as a green library yet. The causes of this situation were identified as the demand for the electronic sources requested by the departments are considerably low. As a result, the space and the furniture allocated for print materials are gradually increasing. Although the library has already been automated, still they use paper for many functions. Although the library automation creates a paperless environment in the library, computers and server machines used for the automation produce CO_2 emission for 8 hours per day. In the old library building, number of fans and lights are operated by a same switch. The production of electricity through solar panel, prevention of misuse of electricity during the working hours, application of cloud computing systems instead of huge server machines, minimizing the paper usage with the use of RFID system, sending circulation notifications via E-mail, encouraging the consumers to use e- resources, provision of smart boards for discussion group, educating the library staff and consumers about green library concept can be used as the solutions to overcome the barriers of making the library green. If this library could apply these solutions innovatively, it will benefit our environment, and also the consumers will enjoy the new library environment which is both environmentally friendly and user friendly.

Keywords: Green concept, Green university, Green library concept, University libraries

Scientometric Analysis of Global Pharmacy and Pharmacology Research

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The present study provides the glimpses of the scientometric analysis on global Pharmacy and Pharmacology research as it has direct impact on the quality of the lives of the people. The study uses the ISI Thomson Reuters' Web of Science database for the collection of data. A total of thirty years data was extracted from the Web of Science database from 1988 to 2017. The study is limited to top ten Asian countries. The CAGR of the global Pharmacy and Pharmacology research is 3.24 % for the period of thirty years. The top ten Asian countries contributed 27.96 % share to the world publications in Pharmacy and Pharmacology. Among the top ten Asian countries, Japan ranked first among the countries with 1,22,269 publications, followed by Peoples R. China (91,440) and India (42,226) respectively. The Average Citations per Paper is 14.47 for Asian Countries. The Transformative Activity Index (TAI) values for China, India, South Korea, Turkey, Iran and Saudi Arabia have been increased remarkably. Iran showed the highest increase in its research activity, followed by China. Among the countries Japan leads with 18,44,844 citations (with 15 Citations per Paper), followed by China with 11,79,986 citations (but CPP is 13), Indian ranked third in terms of citations received (6,69,631) but the CPP is highest (16) compared to Japan and China. Among the top ten productive institutions, Chinese Academy of Sciences top the list with 9,539 publications (1,52,281 citations). According to collaborative authorship pattern the single authored publications have average percentage of 3.65 %, two authored publications contribution is 8.63 %, whereas, the highest contribution has come from multi authored publications (81.88 %) and mega authored publications with 5.85 %. The CAI value of single authored publications of Japan, Turkey, Russia, Israel and Saudi Arabia is more than average.

Keywords: Scientometric analysis, Pharmacy and pharmacology research, Web of science, Publication pattern, Authorship collaboration

Publication Growth of Junglefowl in the Scopus database: A Global Perspective

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This study analysis publication growth of 'Jungle fowl' in the Scopus database during the period from 2008 to 2017. The analysis revealed that the total 182 documents indexed in the database during the selected period of study. This study also analysis Annual Growth Rate, Relative growth rate, Doubling time, Exponential growth rate, Degree of collaboration, Collaborative indices, Collaborative -Coefficient etc. The highest productive year is 2010 with 24 publications (13.2%) and the lowest is 2013 & 2012 with 12 publications (6.6%).162 publications (92.3%) are scholarly articles. The most prolific authors are S. Akhter, M.S. Ansari, M.M. Noordin, B.A. Rakha, and A.B.Z. Zukiwith 8 papers. The most productive country is China with 42 publications. Jungle fowl is a multidisciplinary subject and it includes articles with different areas and the main subject area are found to be agricultural and Biological Sciences having 107 documents. University Putra, Malaysia dominates the other institutions with the output of 21 articles. The famous Journal in this field is 'Plos One' with 10 publications.180 documents (98.9%) are published in the English language.

Keywords: Scientometric, Bibliometric, Jungle fowl, Relative growth rate, Authorship pattern.

R-Statistics Using Reproductive Biology: A Scientometric Approach

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Study describes R-Statistics Using Reproductive Biology: A Scientometric Approach, data was retrieved from Web of Science database. "Reproductive Biology "as a search term in all the field tags fetched 386 communications and the period covered from 1989 to 2018. The downloaded data were analyzed using R-Statistics, MS Excel and VOS Viewer software applications. The analysis revealed that there are 176 authors from among 16 countries; 206 types of documents (Journals, books etc.,); 3151 times cited by local and global references. Indian Journal of Fisheries has produced maximum number of records by this study. The highest productive year is 2016 (43 records). Of the 16 countries, India stands first, United State and England are occupied as second and third places respectively. Among the 1253 authors, "Shivanna KR," has earned the highest publications, h- index average value is 23. Average of citation per article is 8.461.

Keywords: Scientometrics, Biology, India, Reproductive

The Contribution of Public Libraries to Fulfil Information Needs of Rural People (Balangoda Area)

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Public library is a main gateway of a country, which renders a great service to urban and rural community in providing information for developing the society and personal development. The main objective of this research is to identify the contribution of public libraries to fulfil rural information needs of people. Other objective of this research is to identify the information needs of rural community, to understand how people utilize the services provided by the public libraries and identify the issues faced by rural community. The population of this study represents the public libraries in Ratnapura district. Only four public libraries located in Balangoda area were selected as study sample. This study used mixed methodology. Quantitative data were collected through questionnaire and qualitative data were collected through in-depth-interviews. Data analysis was done using Excel and presented by using table, graphical notes and percentages. This study identified that the information needs of rural community are extended in a great range and those necessities vary from person to person. There are factors found affecting the peoples' perception and utilization of information such as age, educational level and occupational status. This study further revealed that rural people face various problems in fulfilling their information needs. Study also revealed that poor mechanism in providing effective services has been a problem in public libraries. On the other hand, lack of information literacy and digital literacy among rural people has also affected them badly to retrieve relevant information from particular information sources. Therefore, this study strongly recommends that proper system to be established in Public libraries of Balangoda area with the support of government authorities for the betterment of the community.

Keywords: Public libraries, Rural areas, Information needs, Rural information needs, Users

Provision of Current Awareness Services by Special Libraries: A Study based on Colombo District

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A special library provides services and specialized information regarding the particular subject to users. Among various Services which are provided by Special library, CAS and SDI services are important. Current awareness is a process whereby the user is kept abreast of the latest literature in his/her field or subject. The main objectives of the study are to identify the most frequently provided service of CAS and SDI services, recognize the objectives of providing the most frequency used service (CAS and SDI), find out the availability CAS in selected libraries and barriers which librarians face when providing CAS. The study based on survey method. Questionnaires were used for data collection. SPSS was used analyzed the collected data. Under the survey research method, 25 special libraries were used as the sample. As the result of the study, most of the libraries provide CAS. The objectives of providing CAS are save the user's time, provide trustworthy information to users and fulfill user's information needs commonly. Most of the libraries provided CAS by displaying new arrivals, paper clipping service, inform ongoing research, making aware of the seminars to be held and Content Page Service. E-mail, social media, and library websites are used to provide CAS. The problems of libraries are lack of human resources to provide services, gab between staff and users and lack of awareness among students about services which are provided by library. The study suggests that, librarians should take possible action on this issue in order to provide effective services. Special training programs to be organized for library staff to improve working efficiency. Marketing tool like, hand books, leaflet to issued for readers to make them aware about the services.

Keywords: Special libraries, Current awareness service, Information services, Library marketing, Information sources.

A Study on User Attitude towards E-Resources Offered by the Vavuniya Campus Library

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Electronic resources which require computer access or any electronic product are materials in the digital format accessible electronically that delivers a collection of data. The main objective of this study is to assess and evaluate the use of e-resources, and to identify the level of satisfaction with the information accessed by the students of the Vavuniya Campus through the available e-resources. The population of this study was 991. The stratified random sampling technique was adopted to select the students as a sample from each of the four departments of the two faculties. Three hundred user questionnaires were administered among the users and only 284 filled in usable questionnaires were returned making a sizable response rate of 94.6%. Descriptive and Inferential Statistics were used in analyzing the data by using SPSS software 22.0. This study confirms that the students (76%) are aware of the e-resources offered by the campus and the majority of the students (84%) prefer to access e-resources as it gives the updated real information very quickly. The final year students (92%) are mostly interested to utilize the e-resources for their dissertation work. Some of the students (32%) reports that they did not access any e-resources offered by the campus. The students (87%) requested to improve the infrastructure facilities of the library so as to access the e-resources from the library. The students (63%) further complained that they are unable to access e-resources outside the campus premises and it seems as a drawback to them to access the e-resources from their residence in leisure time. The analysis found that the students (82%) have positive attitudes about the accessibility of e-resources and they (78%) are satisfied with the available e-resources. It is suggested for the improvement in the access facilities with high Internet speed and subscription to more e-resources. An awareness programme should also be created to increase the usage of e-resources by all the students.

Keywords: Attitude, E-resources, Library, User, Vavuniya.

Open Archives Initiative Protocol for Metadata Harvesting (*OAI-PMH*): A Strategy for Sharing Metadata

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There are a vast and continually growing number of information resources on the World Wide Web such as text, image, audio, video and so on. Many of these resources remain hidden from commonly used search methods, such as Google or Yahoo search engines. Sri Lanka is not an exception to this scenario as majority of the higher educational institutions in Sri Lanka also seem to operate its information resources with less exchange and retrieval of metadata. The interoperability of Open Archives Initiative Protocol for Metadata Harvesting (*OAI-PMH*) is an effective way for complete metadata exchange and sharing. The larger repositories in the world such as *OCLC OAIster, OpenDOAR, Europeana,* etc. bring records using *OAI-PMH* and allow users to search the records of various institutions in one place. This paper tends to apply the *OAI-PMH* related process and related outputs among the Sri Lankan institutional information resources. Also, it discusses about the Sri Lankan institutional information resources interoperability with World Wide larger metadata service providers. The findings show that more than 40 online information portals available in Sri Lanka include universities and research institutions. However, all online resource portals have not been configured for *OAI-PMH* yet. There are only 20 Sri Lankan online portals fully enabled with *OAI-PMH* out of which only 13 on-line portals have been registered and have shared metadata with other larger metadata service providers. At last, the current research article has additionally proposed the applicable technical framework for sharing metadata within the nation as well as outside the country.

Keywords: OAI-PMH, Metadata, Open access, Data sharing, Interoperability

Scientometric Analysis of Electronic-Waste Management Research Output

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This study was carried out to analyze the research field of electronic waste management in terms of publication output as per Science Citation Index (1971-2018) from Web of Science. During 1992- 2018 a total of 187 papers were published by the Comprehensive level scientists. Author, Organization, document & Country-wise distribution of literature Citation Pattern and Author collaboration on E-waste management in India are analyzed. R- Programming software is used to create graphs and maps for the schematic representation of the data. The highest numbers of papers were published in 2017. The most productive author is Garg, V K with 9 (3.67) papers dealing with electronic waste management. The most productive country is India has 163 articles and production frequency of 1630.87. The most productive Journal is Waste Management with 9 papers. Most frequent search term or keyword used is "E-waste", "recycling" and "waste management". The author dominance factor Garg V K comes at the topmost position followed by "Suthar S", "Kumara A" and " Borthakur A", Garg VK has highest h-index and g-index his TC is 287 and NP is 9. Garg VK's m-index is 0.466.

Keywords: Bibliometric analysis, E-waste Management, Citation pattern, India

The Influence of Data Mining Techniques in Library and Information Science

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With the fast expansion of computer technology and web technology, it guides in a new Internet era characterized by knowledge and information. There is an essential for a new generation of computer technologies and methods to develop the resources of information, and to be sophisticated, so as to become valuable and suitable knowledge. Data mining is an extraction of unknown analytical information from huge database. Data mining is the process of analyzing data from various viewpoints and briefs it into useful and needful information. Data mining includes the usage of sophisticated data analysis tools to find previously unfamiliar, usable patterns and associations in large data sets. These tools can include statistical models consequently, data mining consists of more than gathering and handling data; it also includes prediction after analyzing. With the massive volume of data stored in files, databases, and other repositories, it is progressively important to develop very powerful means for analysis and interpret data and extracting the useful and interesting information for good decision-making. Data mining is one step in the Knowledge Discovery in Databases (KDD) process. Data mining extract the inherent link of the heterogeneous information to promote the digital library. This paper describes data mining technologies relating with information science, introduces the process of data mining, illustrates the main features, explores applications in the digital library, specifies application meaning, analyzes the key problems of implementation in digital libraries, the actual assumption of this topic is how the data mining will be useful to extract knowledge from the data ware houses in the synthesized manner.

Keywords: Data mining, Information science

Survey on Availability and Usage of School Libraries in Jaffna: Special Focus to Junior Secondary Students of Valigamam Zone

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The school library system is identified and established as a core supporting system for the development of teaching and learning activities of schools in Sri Lanka. IFLA Manifesto also stipulates that "the school library must be organized and maintained according to professional standards". Jaffna district is the largest in Northern Province by population (622,589). The last two decades of long lasting warfare had caused severe impede in the education, teaching and learning environment. Some studies have been conducted in Sri Lanka on information literacy and school library system. Objective of this study is to identify availability and usage of school libraries in Jaffna with special focus to junior secondary students of Valigamam Zone. Two hundred and fifty two junior secondary school students were randomly selected from nine secondary schools in Valigamam zone. Data was collected using a self-structured questionnaire that covers all the variables under study. They include questions on demographic data, types of information sources available to students, use of information etc. The participants responded to the set of items in the questionnaire by expressing their level of agreement or disagreement based on a 5-point Likert Scale. Research method of this study was quantitative analysis with SPSS software. Findings of this study reveal that School Libraries have been functioning effectively as integral part of the total education programme of the schools. Most of the schools (81%) have separate library building and system. More than 92.1% of students visit to libraries at least once in a week. 78.6 students satisfied with the available books in their libraries. 75% students use library period in libraries and 64.7 % students use library to acquire new information. Only 21.4% of students have satisfied with internet facilities. While 63.9% of students visit library for searching new information only 33.3% students visit to read story books. This study suggests that the Ministry of Education of Sri Lankan should take appropriate measures to enhance the library facilities in schools.(370 words)

Keywords: Information literacy, Library Services, Secondary education, Sri Lanka

A Study on Information Seeking Behaviour of Public Library Users in Salem District

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The present study aims at understanding the awareness of information needs and information seeking behaviour of Public library users in Salem district. The study reveals that: Majority of the respondents were male. The majority of users in the public libraries in Salem district are the employees followed by the students. 26 (22%) respondents are students followed by 17 (14%) respondents who are the farmers. While 62 (52%) respondents are employees, 15 (12%) respondents are businessmen. 31 (26%) respondents expressed that their level of satisfaction on library services was excellent followed by 50 (42%) respondents rating the satisfaction level as good. While 30(25%) respondents are just satisfied with the level of library services being rendered, 09 (07%) respondents expressed their dissatisfaction on the library services. Based on these result it was optional that a questionnaire on public library users ability to use information needs and information seeking behaviour to be prepared reading Newspaper, employment news and preparing for competitive exams etc. It was also suggested that a more insistent information use and information systems should be developed at library users and orientation programme to create awareness among public library users on the existing.

Keywords: Public library services, Mobile services, Information Seeking.

Marketing, Accounting & Finance

- Accounting
- Consumer Behaviour
- Corporate Finance & Governance
- Finance and Banking
- International Trade
- Marketing
- Technology, E- Business and Social Media

The Mediating Role of Brand Love in the Relationship between Brand Experiences and Brand Loyalty (Special Reference to FMCG Sector in Sri Lanka)

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Retail brands have realized the importance of creating a strong brand to be able to differentiate in today's fierce market. To establish a strong brand, current marketers are focused on providing unique and memorable brand experiences which will attach the customer to an emotional relationship that leads to brand love. Experience marketing and brand love are novel concepts in marketing and due to the novelty, limited research has been conducted. This study aims to fulfill these research gaps, by developing a research model shaped by the brand resonance model and customer brand relationship theory to analyses how brand love act as a mediator in the relationship between brand experience and brand loyalty. The study was developed on quantitative approach. Sample consisted of 300 consumers and both multi-stage stratified sampling and systematic random sampling were used as sampling techniques. Data was collected through questionnaires and analyzed using Partial Least Squares Structural Equations Modeling. The findings of the study demonstrates a complementary partial mediation of brand love. The three dimensions of brand experience positively influences brand love, and the sensory experience is identified as the major driver of brand love. Both behavioral and attitudinal loyalty are positively influence by brand love, and out of the two dimensions, brand love has a greater impact to drive attitudinal loyalty. The research model explains 52 percent of variance of brand love, 52 percent of variance of behavioral loyalty and 53 percent of attitudinal loyalty .The study concludes that brand love play a significant role in making a strong positive relationship between brand experience and brand loyalty. Therefore marketers should consistently create authentic customer experiences, that are worthwhile and personally engaging, which will lead the customer to a long term loyalty to the brand and enrich the customer brand relationships.

Keywords: Brand love, Brand experience, Attitudinal loyalty, Behavioral loyalty, Customer brand relationships

Impact of Microfinance Services on Growth of Micro Small and Medium Scale Enterprises (With Special Reference to Micro Small Medium Scale Enterprises in Kalutara District)

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Micro, Small and Medium Scale Enterprises (MSME) sector has been identified as an important strategic sector to create economic and societal sustainability in Sri Lanka. The sector is playing vital role in economic growth, regional development, employment generation and poverty reduction in emerging economy of Sri Lanka. The Micro Finance Institution (MFI) have been developed the variety of services to assist the financial and non- financial needs of the entrepreneurs including credit, saving, leasing, insurance facilities and training programs. The research developed to address knowledge gap which was raised from literature. Therefore objectives derived to explore the impact of microfinance services on growth of MSMEs and explore the impact of micro credit, micro savings, and training on growth of MSME. Further study explores the effect of mediator on growth of MSME through Microfinance services. Sample has been derived from Kalutara district and 100 numbers of respondents have been selected through the random sampling method. Primary data has been collected and administered through questionnaire. The data were analysed using descriptive analysis, correlation coefficient analysis, Regression analysis, Baron and Kenny mediator analysis method and Sobel test. The findings revealed the positive relationship between Microfinance services and growth of MSMEs. Mediator analysis and the Sobel test identified that experience level partially mediate the relationship between the microfinance services and growth of MSMEs. Study recommends to government implement different tax policies for this sector, increase the investment on infrastructure in rural areas and this enable MFIs to maintain lowest rate of interest, increase their outlets in rural areas and to deliver more effective on training programs in order to empower the MSMEs in Sri Lanka to achieve long term sustainability in Sri Lanka.

Keywords: Micro finance services, Micro small and medium scale enterprises, Entrepreneurs, Micro credit

Impact of Social Media Marketing Activities on Consumer Buying Behavior for Casual Dining Restaurants in Sri Lanka

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Effective marketing and promotion strategies gain the customer development, profitability and long-term success for companies. Present market place is more competitive by the way of changing markets, globalization, innovative technology has changed the business world rapidly. Emerging of Social medias such as Facebook, Twitter, YouTube turn companies marketing in to new direction by using the latest marketing concept of Social Media Marketing. Significance of this research is that, social media marketing is open for wide audience, therefore marketers can easily promote the products via social media. Majority of businesses are using social media marketing as a marketing tool hence; this research study investigates whether social media marketing contributes to build and maintain a good relationship with consumer buying behavior. Specially, objectives of this study are to identify the most influential dimension (E word of mouth, Visual appeals, Entertainment, Interaction) in Social Media Marketing which affect towards the consumer buying behavior, measure the level of involvement of customers in social media marketing, and to find out the impact of social media marketing towards the consumer buying behavior. Further, to awaken the minds of future researches towards the social media concepts. Facebook Casual dining restaurant users were represented the population of this research and the sample consists the collected data from 200 online respondents by using proportionate sampling method. The data analysis carried out using SPSS to find out the reliability, descriptive statistics, correlation, regression of the relevant variables. Findings reveal that, social media marketing dimensions positively influence to the consumer buying behavior while E word of mouth is the most significant factor of social media marketing towards consumer buying behavior. Under the managerial implications research reveals that Facebook is a better mode for casual dining restaurants marketing.

Keywords: Social media marketing, E word of mouth, Visual appeals, Entertainment, Interaction, Consumer buying behaviour

Assessing the Impact of Private Label Characteristics to the Brand Loyalty of Private Label Brands

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Present market consist with huge level of competition from both local as well as global context where the marketing signals directly cater to competitiveness. Immense competition of the marketing efforts create modern firms more strategic oriented and leads to innovative promotional methods. Among different competitive strategies, private label branding is a growing phenomenon in self-service retail sector. Supermarket sector become stronger by offering their private label products for customers as low-cost alternatives to national brands. The objectives of the study has been developed as to identify the existing level of the impact of private label characteristics and consumer brand loyalty, to identify the impact and relationship between the private label characteristics and consumer brand loyalty and to recognize the most significant factor that has an effect on consumer brand loyalty of private label brands. Questionnaire survey was used to collect primary data from private label branding consumers. Sample consists with 150 private label branding consumers in Colombo, Gampaha and Kaluthara which derived from multistage sampling method and SPSS was used for data analysis. Descriptive statistics was implied the existing level of private label branding characteristics and brand loyalty ,while correlation and multiple linear regression analysis were used to identify the relationship between the two variables. The study concluded that private label price, private label features and store image have significant impact on private label brand loyalty among other private label characteristics. Managerial implications for the study recommends, self-service retailers need to highly aware quality and shelf space allocation of the private label branding products and always try to maintain the high product quality parallel to national brands.

Keywords: Private label brands, Brand loyalty, Self- service retailers, Consumer behavior

The Impact of Brand Exposure through Brand Ambassador on Consumer Purchasing Intention in Sri Lanka (With Special Reference to Millennial Audience)

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With the increasing competition in today's market, it has become a common practice to use brand ambassadors to endorse brands without being restricted only to celebrity endorsement. Unlike celebrity endorsers who merely appear on advertisements, brand ambassadors represent the company in public as its employees. Companies may often have certain doubts whether they can have a large reach and a positive influence over the marketing process, as they are being signed for a large sum of money. Since most researches have been focused on the celebrity endorsers' impact over consumer behavior, this study's objective is to assess the impact of brand exposure through brand ambassador in terms of ambassadors' gender, credibility, attractiveness, endorsement type and multiple product endorsement on consumer purchasing intention. The sample of this study is 200 millennials from Colombo district, selected using stratified sampling and mall intercept technique who purchase products endorsed by brand ambassadors. A questionnaire was used to collect primary data and analyzed using SPSS software. The results obtained implied that there exists a weak positive relationship between overall brand ambassador endorsements and consumer purchasing intention. It was also observed that endorser gender, endorser credibility, endorser attractiveness and endorser type have weak positive relationships with consumer purchasing intention and a weak negative relationship with multiple product endorsement. Hence it can be concluded that all the dimensions have a significant impact on consumer purchasing intention in Sri Lanka. Further, according to the regression model, endorser credibility was identified as the most influential factor for consumer purchasing intention. Thus, it is recommended that when selecting brand ambassadors, marketers should be more focused on the expertise of the endorser which makes him/her credible for the marketing of the product or service than other attributes.

Keywords: Brand ambassador, Consumer purchasing intention, Marketing

A Qualitative Approach to Explore the Promotional Behavior of an Entrepreneur: With Special Reference to Tourism Sector

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SMEs are known to be strong economies' heart, as well as being the backbone of development in economics. World Tourism Organization states that tourism as an important contributor to the economic recovery of many countries and creating jobs with an intercorrelation with SMEs by playing an interacted role with each other as an important strategic sector for promoting growth and social development of a country. In a highly competitive arena, marketing is an essential tool to attract tourists for an SMTE. But some scholars have questioned whether entrepreneurs have an intention to adopt marketing practices within SMEs. Therefore, this research is to explore a new theoretical knowledge regarding promotional behavior of tourism entrepreneurs within the Sri Lankan context. Snowball sampling used to select the sample of 20 Micro Small and Medium Tourism Entrepreneurs from the population of Micro Small and Medium Tourism Entrepreneurs in Badulla District. Based on a qualitative approach, thematic analysis was used to generalize the findings through interview transcriptions and observations. Study results on tourism SME shops are following implicit and simple marketing method to retain profitably and study has explored that entrepreneur's experience, feasibility, and personal traits impact on marketing adaptation in SMTE. This study provides theoretical and practical implications for the entrepreneurship field in marketing perspective. Build a common brand can increase the reputation and trustworthiness, conduct conferences to share education and technology, encourage entrepreneurs to discover innovative promotional strategies and finally, develop a forum to appreciate the entrepreneur's contribution to the promotional adaptation and innovations can be developed as recommendations for the government and entrepreneurs to maximize the wealth by efficiently adopting promotional strategies in SMTEs as well as uplifting the existing theories of promotional strategies.

Keywords: Small and medium scale enterprises, Micro small and medium tourism enterprises, Promotional behaviour, Entrepreneurial marketing

Does the Loyalty Cards Impact on Consumer Buying Behaviour? Study Based on Retail Clothing and Fashion Stores in Sri Lanka

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Marketing is a complex, interesting and more adventurous field involved with informing, persuading and reminding customers with the use of its most sophisticated strategies and techniques creating immense competition. Where, Loyalty programs are one of the marketing strategies in attracting and winning customer loyalty, while occupying the markets through variety of facets. Loyalty card programs of loyalty programs, being popular and a competitive tool, made it questionable on its efficacy due to its' rapid proliferation effects and on industry dynamics. There by this study has been developed to identify the impact of customer loyalty cards on consumer buying behavior with special reference to supermarkets and retail clothing and fashion stores in Sri Lankan context, with a sample of 210 respondents from Colombo district, derived by multi stage sampling method out of the population. Tested through a survey at supermarket premises and retail clothing and fashion stores, being analyzed using descriptive statistics, correlation and multiple regression analysis of statistical software SPSS 21 , the findings revealed, loyalty card programs do highly influence over the consumer buying behavior posing positive association between variables. While, program related factors; one of the independent variables, highlighted as the most influencing factor. Thereby, the study recommends to enhance customer engagement through the provision of enthusiastic loyalty card program experiences and monetary benefits and ensure instantaneous customers' awareness on promotional efforts of organizations. Further, as managerial focuses in successful implementation and maintenance of loyalty card programs should be; executive management and cross functional team support, while continuously innovating to differentiate the loyalty program structures, targeting the most sensitive category of youth and establishing a feedback system in considering customer suggestions.

Keywords: Marketing strategies, Loyalty card programs, Program related factors, Consumer buying behaviour

Do Self-Congruity Impact on Consumer Buying Behavior? Study Based on Condominium Market in Sri Lanka

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Urbanization and land shortage has contributed for dramatic changes of a society including their life style, social links, family structure, as well the housing. It has increased the demand of the housing options in the country. The highest value segment's housing option in this market is the condominium sector. Further, this novel market trend has been developed recently within Sri Lankan context, and it is developing with the emergence of large number of condominiums within the country. Sri Lankan Condominium market shows a significant extend in buying behaviour over the past few years particularly in the Western Province. Self-congruity is a concept that shapes a consumer's behaviour of purchasing a product according to the reflection of the user's self-image given through the usage of the relevant product. With the dramatic changes in the life styles of the consumers due to the industrialization and living status, Self-congruity concept has become a new arena for the marketing world. Self-congruity is the feeling of the consumer on relatedness of the product on his view of who he is and who he would like to be. The objective of this study is to identify the impact of self-congruity on consumer buying behaviour in condominium market. All the certified condos in Sri Lanka are situated in Western Province. With accordance to that, the data was collected through survey method from respondents residing in condominiums in Western Province by using convenience sampling method. The data analysis was done using correlation coefficient, regression analysis, and descriptive methods and the results revealed a strong positive relationship between self-congruity and consumer buying behaviour. The research findings reveals that the marketers and the condominium constructors can attract more customers condominium buyers can shape up their buying decisions based on the self-concept. Study recommends using the variables self-image congruity for segmentation purposes of the products, managing information about the self-congruity of customers to improve marketing strategies could be adopted as the managerial implication to the industry.

Keywords: Self-Congruity, Consumer Buying Behaviour, Condominium, Urbanization

The Study on the Relationship between Dividend Payout and Firm Performance: With Special Reference to Listed Manufacturing Firms in Sri Lanka

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Manufacturing industry plays a vital role in enhancing Gross Domestic Production of a country. Dividend is a distribution of firms' gains among their shareholders and it may be in cash payments or by issuing of additional shares. Dividend pay-out directly related with firm performance of the manufacturing firms and therefore studying the relationship between dividend pay-out and firm performance is very essential for all internal and external parties of the industry. The purpose of this study is to identify the relationship between dividend pay-out and firm performance in Sri Lankan listed manufacturing firms. Moreover, the study attempts to examine the impact of dividend pay-out on firm performance in listed manufacturing firms in Sri Lanka. Data were collected from financial statements of 11 listed manufacturing firms in Colombo stock exchange over the period from 2011 to 2017. Analytical tools such as correlation and panel-data regression analysis were used for analyzing data along with descriptive statistics. Return on assets and return on equity were used as firm performance indicators while dividend pay-out ratio to measure dividend pay-out variable. Firm leverage which was measured by debt ratio was identified as the control variable. The findings of this study reveal that dividend pay-out ratio has a significant and a positive relationship with both return on assets and return on equity. The firm leverage shows a significant and a negative relationship with return on assets and return on equity. According to the results, dividend pay-out has significant and positive impact on firm performance in listed manufacturing firms in Sri Lanka. This study provides valuable information for investors and financial managers to make sound investments and financial decisions to maximize their wealth portfolio and profit level. Furthermore, the top management can use this information to formulate an effective and efficient dividend policy.

Keywords: Colombo stock exchange, Dividend pay-out, Firm performance, Return on assets, Return on equity

Cost and Benefits Analysis for the Expansion of Water Supply Scheme in Bibile

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The existing Bibile water supply schemes are insufficient to serve entire public living in Bibile. Therefore, it is essential to expand the existing scheme to serve about 40,000 public lives in Bibile. This study area consists of 31 out of 40 Grama Niladari Divisions of Bibile Divisional Secretariat Division (DSD). The main objective of this study is to analysis cost and benefits form the expansion of water supply scheme in Bibile to find the financial source for implementation. The primary data for this study were collected by the Interviews, questionnaire and provided information by National Water Supply and Drainage Board (NWSDB), Divisional Medical officer of Health, DSD office and GN's of relevant GND's. Initially the detailed design was done and the total cost estimate (TCE) for the expansion of existing scheme was estimated according to the year 2017 rates of NWSDB. The construction period was decided as three years. Operation and Maintenance (O&M) cost of project was estimated for the period of design life of scheme. Finally, Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated separately for the discounting rate from 5% to 10%. The TCE amount was estimated as 2, 749.8 million Sri Lankan Rupees for expansions. During the design life of the scheme, the annual O&M cost is in year 2020 is 28.8 million and in year 2040 is 133.8 million and Annual revenue and benefits due to the expansion of scheme in year 2020 is 207.9 million and in year 2040 is 697.6 million respectively. As per the cost benefit analysis for loan payback period of 20 years with the Grace period of 3 years, the project is operationally viable financial to obtain a loan or any other financial assistance to implement the proposed scheme since the NPV is positive up to 8% of discounting rate. It is proposed to obtain 2,750 million of financial assistance within the 8 % of discounting rate from suitable donor agency to implement the project. The coverage of water supply will be increased due to the expansion of existing scheme from 22.5 % to 84 % in this study area.

Keywords: Water Supply, Cost estimate, Net present value, Internal rate of return.

Impact of Corporate Social Responsibility Disclosures on Institutional Ownership of the Highest Turnover Non-Financial Companies in Sri Lanka.

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Corporate Social Responsibility (CSR) is a vital source for organizations to increase their social reputation in the competitive markets. Organizations actively participate to disclose their CSR activities through annual reports in order to make an overall picture of the organizations' social value creation process. Institutional Owners (IO) are one of dominant party who has high investment portfolios. However, there is no consensus in the literature about the impact of CSR Disclosures (CSRD) on IO in Sri Lankan context. There for this study examines the impact of CSRD on IO of the highest turnover non-financial companies in Sri Lanka. Data were collected from annual reports of 25 listed non-financial companies which are categorized under LMD 100 in Sri Lankan Business Magazine (SBM) over the period from 2011-2017 based on annual turnover. CSRD measured through a grading procedure under 67 disclosure items and IO indicated through number of shares owned by institutional owners. As control variables, firm leverage and firm size used. Descriptive statistics, correlation analysis and random effect regression model of panel data analysis were used for the statistical analysis. The finding of this study revealed that there is a significant and positive relationship between CSRD and IO. Furthermore, CSRD significantly and positively impact on IO. Firm leverage negatively impacts on IO while firm size positively impact on IO. In conclusion, it is confirmed that, when non-financial companies engage with effective CSR disclosure procedure, institutional investors tend to invest in those companies with the feeling of less risky investment. The findings of this research will be crucial to the non-financial companies in Sri Lanka to enhance the disclosing procedure of CSR in order to gain more institutional investors' attraction and results also will provide guidance for organizations which are engaging with poor CSR disclosures.

Keywords: Corporate Social Responsibility (CSR), Corporate Social Responsibility Disclosures (CSRD), Institutional Ownership (IO), Sri Lanka Business Magazine (SBM)

Impact of Loan Portfolio Diversification on Performance of Commercial Banks in Sri Lanka

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Credit risk attached with commercial bank loans can be considered as one of the main risks which commercial banks face. Thus, commercial banks diversify their loan portfolio to enhance performance through mitigating the credit risk. Loan portfolio diversification refers to providing loans to different sectors without concentrating on a particular sector. However, there is no consensus in the literature about the link between loan portfolio diversification and performance of commercial banks. Therefore this study examines the impact of loan portfolio diversification on performance of commercial banks in Sri Lanka. Hirschman Herfindahl Index was used to measure the loan portfolio diversification while performance measured by the CAMEL model. The Interest Rate Spread and Bank size were considered as the control variables. The sample consists of ten licensed commercial banks including six systemically important commercial banks in Sri Lanka out of 25 licensed commercial banks and the sample period spans for ten years from 2008 to 2017. The data were collected from published financial statements of sample companies and analyzed by using Pearson correlation coefficient and fixed effect panel regression model. The results revealed that there is a significant negative impact of loan portfolio diversification on performance of commercial banks. Further, both control variables-bank size and interest rate spread show a positive impact on performance of commercial banks. In conclusion, it is recommended that commercial banks should reduce their loan portfolio diversification as much as possible to increase the performance. The management should develop specific strategies on Loan Portfolio Diversification in order to improve the performance while paying high attention on loan portfolio position of the bank.

Keywords: Credit risk, Loan portfolio diversification, Loan portfolio concentration, Hirschman herfindahl index, Interest rate spread

The Impact of Corporate Social Responsibility on Competitiveness of SMEs in Sri Lanka: Special Reference to Gampaha District

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Corporate Social Responsibilities (CSR) has become an important strategy for gaining competitive advantage. Small and Medium Enterprise (SME) sector is playing a major role especially in a developing economy like Sri Lanka and trend to fail due to various reasons like lack of competitive Strategies. Therefore, it is necessary to identify how significantly the CSR influence on the competitiveness of the SMEs. The primary objective of the research is; "to investigate the impact of CSR on competitiveness of SMEs in Sri Lanka". The secondary objectives were "to investigate the relationship between each factor of CSR and competitiveness of the SMEs in Sri Lanka" and "to identify the most influential factor of CSR on competitiveness of the SMEs in Sri Lanka". A self-administered questionnaire was fielded to collect primary data over a conveniently drawn sample of 100 respondents who were the owners and the managers of SMEs. Descriptive statistics, correlation coefficient and regression analysis techniques were used to analyze the data. According to the findings social oriented CSR activities has the most significant impact on the competitiveness of the SMEs and environment oriented CSR activities has the least impact. Therefore the SME owners and manager should carry out CSR program to increase the impact of all these factors majorly social oriented CSR activities. Because it gives a strong significance. Since all four factors have a positive impact towards the competitiveness of the SMEs, by improving the impact of them will affect positively to the enterprise to gain long term competitive advantages.

Keywords: Corporate social responsibility, Competitiveness, Small and medium enterprises

Impact of Cash Conversion Cycle on Firms' Profitability (Special Reference to Listed Beverage Food and Tobacco Companies in Colombo Stock Exchange)

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The Cash conversion cycle, where the decisions about investments in accounts receivable and inventories and about acceptance of credit from suppliers. It is one of the most generally utilized estimations to evaluate the risks and returns associated with liquidity management. Every corporate organization is extremely concerned about how to sustain and improve profitability, hence they have to keep an eye on the factors affecting profitability such as inventory management, accounts receivables and also accounts payables. Consequently, the main purpose of the study is to identify the impact of CCC on firm's profitability with reference to the Beverage Food and Tobacco industry. The study is concerned about evaluating how CCC impact on the profitability of Beverage Food and Tobacco sector companies listed in CSE in Sri Lanka. The profitability was measured in terms of Return on Equity (ROE) and Return on Assets (ROA). The CCC was determined by Inventory Conversion Period (ICP), Receivable Conversion Period (RCP), and Payable Conversion Period (PCP). The study covering a sample of 14 Beverage Food and Tobacco companies and data were collected by concerning the time period from 2009 to 2017. Correlation statistical techniques and Panel data regression were used to analyze the relationship and impact the between CCC and the firm's profitability. Results revealed that ICP has a negative relationship and significant impact on the firm's profitability. Further RCP and PCP are positively impacted on ROE and ROA. Finally, overall CCC negatively correlated with the firm's profitability and has a significant impact on firm's profitability. Therefore, the study suggested that managers can create value for their shareholders by reducing the number of days of overall cash conversion cycle to a reasonable minimum.

Keywords: Cash conversion cycle, Return on assets, Return on equity, Working capital management

Cashless Economy in Tamil Nadu: Problems and Prospects

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Cashless economy is an economy where financial transactions are conducted online. There is no involvement of cash in a cashless economy. Digital currencies such as bitcoin can be used for conducting cashless transaction. Electronic payment has become more popular with the arrival of intermediaries such as Paypal and digital Wallet systems. The fund transfer between banks can be easily made through net banking. As per the current Indian scenario most of the urban people have shifted to cashless transaction with the easy accessibility of computer and networks. As far as rural people are concerned the level of involvement in cashless transaction is still low because of the inaccessibility to technology. The payments in a Cashless economy are made through various modes like mobile banking, Debit Card, Credit Card, Google Pay and PAYTM. The paper discusses the various cashless payment modes, benefits and challenges of cashless economy and the awareness level towards cashless transaction modes. The researcher has used convenience sampling method for selecting 100 respondents from rural and urban areas of Tamil Nadu using a google survey. The result shows that awareness level of individuals regarding cashless transaction significantly differs with respect to age, gender and education.

Keywords: Awareness level, Benefits, Cashless economy, Challenges, Payment modes.

Integrated Reporting Disclosures: An Empirical Analysis

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Integrated Reporting has come to the financial reporting arena as a newly emerged concept which depicts the holistic view of an entity. IR is still diffusing among companies since it has not yet become a mandatory reporting requirement in most countries. Hence, entities voluntarily adopt IR for their reporting. Unavailability of regulation over adoption of IR induce companies to adopt IR in various scales and even various aspects. Thus, it is essential to investigate the level of IR adoption and which dimensions companies mostly concentrated as IR disclosures. Therefore this study focuses to investigate how well companies disclose IR elements in their integrated reports and the level of IR adoption in companies listed in Colombo Stock Exchange. Objectives of this study are to analyze the level of IR adoption and examine the disclosure dimensions in IR. All 48 companies which have adopted IR by 2015 were selected as the sample. Data were collected from year 2015 to year 2017. For this study, self-constructed scoring model and index were developed with the assistance of Integrated Reporting Framework articulated by International Integrated Reporting Council (IIRC). 31 items were included in the index under 8 dimensions such as organizational overviews and external environment, governance, business model, risk and opportunities, strategy & resource allocation, performance, outlook and basis of preparation & presentation. *Kudar-Richardson 20* test was employed in order to ensure the reliability of the data set and it suggested that the items have relatively high internal consistency. The findings revealed that companies have moderately adopted IR for their reporting perspectives. Most reports highly demonstrate the elements of basis of preparation and presentation and performance of the entity. The total average scores for performance and basis of preparation and presentation are 0.902 and 0.907 respectively. Strategy & Resource allocation component is the lowest reported component in the integrated reports as its average total score is recorded as 0.59. All components other than Risk and Opportunities component have increasing trend over the period of 2015 to 2017. Reporters seemingly paid more attention to record items which are mandatory to report under the various regulatory frameworks and accounting standards. Hence, it is clear that voluntarily adoption of IR is still in lethargic situation in Sri Lanka. Findings of this research will beneficial for both IR adopted companies as well as non-adopted companies. The findings of this study provide an insight for companies to rethink whether their so called integrated reports really depicts the integrated aspects.

Keywords: Colombo stock exchange, Integrated reporting, Integrated reporting disclosures, Integrated reporting framework, IR Index

Empirical Study on Determinants of Capital structure: Panel Data Analysis for Listed Manufacturing Companies in Sri Lanka

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The optimum capital structure remains ambiguous despite extensive empirical research attempts and theoretical literature. Traditionally debt is often thought of as purely bad given the negative consequences of higher leverage levels. The study reveals that Sri Lankan manufacturing companies prefer short-term debt to long-term debt thus maintaining a considerable level of leverage at an aggregate level. Proper capital structure leads a firm to take advantage of cheap cost of debt and tax shield on interest payments thereby increasing the company performance, firm value, shareholders wealth and investor confidence. This investigation is conducted, with a particular regard to Manufacturing Companies listed in the Colombo Stock Exchange for the period from 2011 to 2018, in an attempt to establish a relationship between capital structure and its determinants. Panel data analysis, undertaken for 203 observations collected from 29 listed manufacturing companies, generated results that are simply not detectable in pure cross-sections or pure time-series studies. The leverage level of the companies, measured by long-term debt ratio, short-term debt ratio and total debt ratio, is termed as the dependent variable. The tangibility, profitability, firm size, firm growth and investor confidence are termed as independent variables. The Fixed Effects regression model revealed the influence of aforementioned variables and the results further validated some empirical and theoretical evidence such as pecking order theory and trade-off theory but it also held evidence to the contrary. Further, this study prompts the manufacturing companies to employ short-term debt such as revolving credit facilities and financial institutions to introduce new short-term debt products given the nature of manufacturing companies. The Fixed Assets are appeared to have used to collateralize against short-term debt as they become outmoded due to frequent replacement cycles and technological advancements.

Keywords: Capital Structure, Panel Data, Determinants, Leverage level

Trade-off between Working Capital Management and Firms profitability: Panel Data Analysis Based on Listed Manufacturing Companies in Sri Lanka

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Working Capital Management is central to get the right balance between profitability and short-term liquidity of a firm. The study is undertaken to uncover the impact of Working Capital Management on firm performance thereby providing a framework for emerging firms to learn from the best practices. Working capital management leads a firm to generate sufficient funds to be able to meet its immediate obligations and therefore to continue trading. Financial figures all look good on paper as higher profitability does not always guarantee liquidity; this relationship is more pronounced in the context of Working capital management. In response, this study investigates Manufacturing Companies listed in the Colombo Stock Exchange for the period from 2011 to 2018, in an attempt to establish a relationship between working capital management and firm performance. The results, analyzed by Fixed Effect regression model, demonstrate that working capital management should be factored in firms' financial planning. Panel data analysis, undertaken for 196 observations collected from 28 companies, generated results that are simply not detectable in pure cross-sections or pure time-series studies. The Gross profit margin, Operating profit margin, Earnings before Interest and Tax, Return on assets are termed as independent variables whereas Efficiency ratios, liquidity ratios, Current liabilities-to-Total assets ratio, Current liabilities-to-Total fixed assets ratio, firm size and sales growth were dependent variables. The results depicted a negative relationship between Return on Assets and Current ratio. In contrast, a positive relationship is uncovered between Return on Assets and Quick ratio. The growing companies depicted a negative relationship with Inventory and receivable days ratio, and a positive relationship with payable days ratio. The study suggests a practical guide to manage trade-off between Working capital management and firm performance in the context of liquidity.

Keywords: Working capital management, Firm performance, Short-term liquidity, Panel data, Operating cycle

Relationship between Earnings per Share and Share Price: Evidence from Listed Beverage Food and Tobacco Companies in Colombo Stock Exchange

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The purpose of the study is to examine the relationship between Earnings per Share (EPS) and share price of listed beverage food and tobacco companies in Colombo Stock Exchange. As per the availability of the data for the period of 5 years from 2012-2016, 18 companies were selected for the empirical analysis. Return on assets and firm size were considered as control variables on the relationship between EPS and share price. Ordinary Least Square analysis was performed to examine the relationship with the aid of STATA. Results of the study revealed that there is a significant positive relationship between EPS and share price of listed beverage food and tobacco companies and there is no significant relationship between control variables and share price. Outcome of the study may be useful to the potential investors to make their investment decision in the stock market. This study has conducted using only one independent variable, with the small number of sample companies. Therefore, this research can be developed in the future by enlarging the number of variables and sample.

Keywords: Earning per share, Firm size, Return on assets, Share price

Impact of Credit Risk Management on Financial Performance of Licensed Commercial Banks and Licensed Specialized Banks in Sri Lanka

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Credit risk management of banking sector has become more a crucial aspect of financial system, since it has been facing difficulties over the years. It refers a situation where the borrower has failed to repay loan or interests when they are due. Hence this study analyzed the impact of credit risk management on financial performance of licensed commercial banks and specialized banks in Sri Lanka. And the study further attempts to examine nature of aforementioned relationship based on banking soundness index indicators CAMEL (Capital adequacy, Assets quality, Management efficiency, Earnings and Liquidity). Return on Equity, Net Interest Margin and Earnings per Share used as the measurements of financial performance. Bank size considered as a control variable. Data were collected from 12 commercial banks and 3 specialized banks out of 32 banks in Sri Lanka. The key data source is the audited annual financial statements of selected banks over the 7 years (2011-2017). Pearson correlation and random effect panel regression model were employed to analyze the data. The results revealed that Capital adequacy and Asset quality have negative insignificant impact on financial performance while Loan to Deposit has negative and significant impact on financial performance. In contrast, Management efficiency and Earnings have positive significant impact on financial performance of LCBs & LSBs in Sri Lanka. Therefore, this study suggests that CAMEL model can be used as a proxy for credit risk management and conclude that credit risk still remains a major predictor of the performance of banks in Sri Lanka. The study recommended that banks should initiate Basel III framework, hedge the risk, do the loan portfolio diversification and integrate proactive & reactive approaches to mitigate the credit risk as much as possible to earn high performance and to reduce the compliance risk as well.

Keywords: Credit risk management, Financial performance, CAMEL, Licensed commercial & specialized banks in Sri Lanka

A Study to Assess Impact of Attitude on e-shopping Behavior of Consumer's Household Electronic Items Mediated by Purchasing Intention

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The emerging digital economy has opened new chapter for e-retailing. Nowadays, E-shopping has become trending filed either no research or a proper discussion conducted in Sri Lanka. Attitude towards E-shopping's behavior has been ever changing at a rapid pace with diversifications. E-shopping attitude refers to consumers' psychological state of making purchases via Internet. Hence, the study has been addressed two objectives; to identify impact of attitude on E-shopping behavior of consumers, to identify the impact of attitude on E-shopping behavior of consumer purchasing household electronic items mediated by purchasing Intention. Sample has been distributed from 300 E-shoppers in western province following multi-stage sampling method and data has been gathered through google form. Based on analysis data, largely consumers buy household electronic items (42.3%) via E-bay. Coefficient Correlation and Regression analysis base results Attitude revealed a positive impact on E-shopping behavior while Subjective norms and Perceived usefulness shown the significant relationship with E-shopping behavior. According to Baron & Kenny Mediator analysis has shown a significant mediating effect (34%) of Purchasing intention on the relationship between Attitude & E-Shopping Behavior. The research had yielded fruitful results to realize that Sri Lankan people face delay delivery and cheap quality products mainly. Also, majority of female young educated consumers are interested in doing E-Shopping but hesitate to purchase luxury products due to lack of trust towards e-retailers. As the recommendations, websites must hike the customer's feedback level, low cost of products, services & many other features regarding purchasing. Further study suggests managerial implications as digital market platform development standards in Sri Lanka.

Keywords: Online Shopping behavior, Attitude, Purchasing intention, Household electronic items

A Study on SME's Adoption of Internet Banking in Sri Lanka

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Internet banking activities came into existence as a result of the evolution of new technology and it allows the customers to undertake their banking activities even staying at home. In general it is a feature introduced by the banks to its customers to log into their individual registered domain account on bank website and do almost every transaction they do by visiting the bank. It is a good opportunity especially for the business owners of the country. Owners of Small and Medium Enterprises (SMEs) play a vital role in today's business world. When making business decisions, owners'/managers' characteristics are considerable and their adoption to e-commerce is significant. Hence, the current study investigate the SMEs adoption of internet banking in Sri Lanka. The researcher's attempt is to identify the level of internet banking adoption by SMEs, the impact of perceived ease of use, perceived usefulness and attitude on internet banking adaptation and the most significant factor impact on internet banking adoption by SMEs. For the current investigation, all the consumers who use internet service in SMEs in Colombo District is used as the target population and 200 consumers (SME owners) are selected as the sample by using stratified sampling technique. Primary data was collected through a self-administered questionnaire. The collected data was analyzed using correlation analysis, regression and descriptive analysis methods. The findings of this study supports the previous findings on the similar area. The results of this study showed that there is a positive impact of perceived ease of use, perceived usefulness and attitude on internet banking adaptation. Further, it revealed that all factors are positively impact on internet banking adoption by SME's while perceived usefulness showed the highest impact.

Keywords - Perceived ease of use, Perceived usefulness and attitude, Internet banking adaptation

Mapping of the Maize Value Chain and Assessment of the Relationship Between the Buying Price and Farmer Loyalty towards the Buyer: A Study in Anuradhapura and Monaragala Districts

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Maize, the key ingredient of provender products receive a high demand from poultry feed producers. As a result, outgrower operating Agribusiness firms engaged in maize farming promote the maize cultivation while developing a loyal farmer group by helping them to mitigate limitations in production. Importance in identifying inefficiencies exist in this vertical integration is to reduce main affective factors by agribusiness firms for their long term sustainability. Therefore, the main objectives were to identify the nodes of the maize value chain, to assess the value addition at the upper stream nodes and to measure the farmer loyalty and success of adapting outgrower operations for a guaranteed supply. Convenience sampling and value chain analysis was adapted to map the value chain and to assess the value addition. Multistage cluster sampling was adapted to select a sample of 67 outgrower farmers. Farmer loyalty was assessed by adapting Farmer Loyalty Index and Spearman's correlation test was used to detect any relationship between a firm's price and farmer loyalty. Results revealed that farmers access multiple inputs suppliers and their direct buyers could be a collector, stockist or even feed miller. Direct sales for outgrower operators and drying as a value addition enable farmers to obtain higher income from maize cultivation. Although majority showed a higher loyalty perception, outgrower operations was a less effective strategy of developing the farmer loyalty because they are highly sensitive to the net per kilo price. Due to lack of farmer assurance of direct sales with outgrower operator, outgrower farming has become a less effective business strategy in Sri Lanka. Therefore, conducting the outgrower operations with the collaboration of government while establishing responsible farmer organizations is more convenient to obtain positive outcome during buying back operations and to overcome the loopholes in national policy development especially in pricing.

Keywords: Farmer loyalty, Maize value chain, out-grower operations, Pricing

Impact of Brand Personality on Word of Mouth Communication (Empirical Evidence from Sri Lankan Beer Industry)

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With the development of the society, people have tended to the consumption of the Tobacco and Alcohol products more than past. This could be as their entertainment activity or as a habit. However, due to reasons like these the beer consumption in the Sri Lanka has been increased in previous years. As a country with full of ethical values it is not allowed by the government to promote these alcohol and tobacco products in public in Sri Lanka. Hence in such cases, alcohol and tobacco produce organization may have no any other remedy to advertise their products, but WOM Communication. Hence, in this study researcher has investigated to accomplish objectives such as find out the relationship between the brand personality and WOM communication As well as to find out the impact of brand personality on WOM communication and to find out the most influential dimension which affect WOM communication in the context of Sri Lankan beer industry where dark marketing conditions are prevailing. The researcher gathered data from 150 respondents from 15 Divisional Secretariats in Badulla district using the convenience sampling technique. Through survey method has analyzed using statistical tools (SPSS). The results of the study indicated that there is positive relationship between brand personality dimensions and WOM communication. The study concluded that Excitement, Sincerity, Ruggedness, Competence, Sophisticate dimensions are significantly impact on WOM communication in the context of Sri Lankan beer industry rather than Competence dimension. Finally, the present study indicated that the positive relationship obtained between the brand personality and WOM communication in the context of Sri Lankan beer industry.

Keywords: Brand personality, Word of mouth, Beer industry

Impact of Brand Personality and Brand Engagement on Purchasing Behaviour of Cosmetics Products: Is There Any Mediating Effect of Brand Trust?

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Branding is a vital factor in the current market set-up in creating competitive business opportunities. Brand personality, brand engagement and brand trust are highly contributory brand related attributes for creating a positive brand image, affecting consumer purchase behaviour. However, lack of research attention has been given on these concepts integrated together as a whole. Therefore the primary objective of the research was to bridge this research gap while identifying the impact of brand personality and brand engagement on consumer purchase behaviour. The study developed a model to identify the impact of brand personality and brand engagement on consumer purchase behavior of cosmetics products. Further the mediating effect of brand trust has been examined. Data was collected from 300 cosmetics product consumers from Western Province using multistage sampling. As the analysis methods; Descriptive analysis, Coefficient correlation, Regression analysis, and Mediator analysis have been conducted. Baron and Kenny mediator analysis method was conducted to identify both the mediatory effect and the indirect effect of the variables. Findings revealed a strong positive association between brand personality and brand engagement on consumer purchase behavior, and brand engagement was identified as the most contributory factor. Further, findings revealed that brand trust partially mediates the relationship between the two independent variables with the constant at values of 66.3% for brand personality and 29.3% for brand engagement. The results provide useful insights to brand, marketing and product design managers in order to formulate competitive business strategies. The study highlights the need for more consumer involved branding strategies in order to ensure that the customers are more engaged with the brands which reflect their personality traits.

Keywords: Brand personality, Brand engagement, Brand trust, Consumer purchase behaviour, Cosmetic industry

Impact of Individual Perception on Online Purchasing Intention (With Special Reference to Executive Level Employees in Badulla District)

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Technology evolves at a very fast pace, sometimes faster than the users can accept and adopt it. With the huge development of the technology people have more incline with online, physical retail shops, retailing has found its way onto the online platform as organizations seek to reach as many clients as possible. Online platform poses as a viable substitute for the traditional brick and mortar set up. The purpose of this study was to determine the Impact of individual perception on online purchase intention of executive level employees in Badulla district. A quantitative study was carried out with 200 respondents that included executive level employees from the Badulla district. The individual perception on online purchase were determined by the Perceived Transaction Security (PTS), Perceived Ease of Use (PEoU), Perceived Usefulness (PU) and Perceived Knowledge and Ability (PKaA). Descriptive statistics and regression analysis were used for the analysis. The study found that there is a strong positive relationship between individual perception and online purchasing intention of executive level employees in Badulla district and Perceived Knowledge and ability was the most significant variable which effect to online purchase intention, value is 0.358. The study was made following recommendations: more online shops should be set up to increase competition. Existing online shopping platforms in the Sri Lankan market should always be on the creative edge to continue being useful to the consumer; online shops should be user friendly and very easy to use, most of the users are dominated by the younger generation, so with the changing age will generate and opportunity for the adjustment in consumer good which target the elder generation.

Keywords: Perceived transaction security, Perceived knowledge, Perceived ease of use, Perceived usefulness

Relationship between Macro Economic Variables and Share Prices (A Study on Colombo Stock Exchange)

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This study was done with the aim of finding the relationship between All share price index of Colombo stock exchange of Sri Lanka and the macro economic variables. Therefore, the main purpose of this study is to identify the relationship between macroeconomic variables and share prices of Colombo stock exchange There have been 3 major macroeconomic variables under consideration namely, Interest rate – Colombo consumer price index, Exchange rate – US dollar rate and Inflation rate – three-month treasury bill rate. Monthly data has been collected and analysed in order to arrive at conclusions, which include a null hypothesis stating that above macroeconomic variables have no effect on the stock prices. This study is based on a multi regression model where there is more than one independent variable. The E-views software has been used for the analysis and to reveal all the hidden relationships. This study revealed that, all share price index has a strong relationship with exchange rate. These result is useful for potential investors, government and regulatory authorities, firms in the stock market.

Keywords: Index Terms—Interest rate, Exchange rate, Inflation rate, All share price index, Macroeconomic variables.

Impact of Cash Conversion Cycle on Firm's Profitability: With Special Reference to Beverage Food and Tobacco Sector

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Cash Conversion Cycle (CCC) is the most widely used evaluation method to measure the risks and returns associated with liquidity management and profitability. Therefore, the main purpose of the study is to identify the impact of CCC on profitability selected companies in Sri Lanka. The profitability of companies was measured in terms of Return on Equity (ROE) and Return on Assets (ROA) and the CCC was measured by Inventory Conversion Period (ICP), Debtor Conversion Period (DCP), and Payable Conversion Period (PCP) taking into account the financial data for two years period from 2015 to 2016. According to the findings of the regression, ICP shows the impact on profitability of firms (ROE: β = .072, P = .000, ROA: 001, P = .000). The results indicated that if ICP increase, from one day ROE and ROA increased by 0.072 and .001 when other variables are constant. DCP also have impact on profitability (ROE: β =126.377, P = .000, ROA: β = 0.124, P = .021). That indicates that if DCP increase, from one day ROE and ROA increase by 126.377 and 0.124 when other variables are constant. PCP also have impact on profitability (ROE: β = -243.843, P = .039, ROA: β = -1.605, P = .046). In turn if the PCP decrease, from one day ROE and ROA decrease by -243.843 and -1.605 to the extent other variables are constant. By considering the results revealed that ICP and DCP has positive strong relationship with the profitability. Further the study found that the PCP are negatively affected to the ROE and ROA. According the study reveals that CCC negatively correlated with the profitability and CCC has significant impact on profitability. These results suggested that managers can create value for their shareholders by reducing the number of days of account receivables and inventories to a reasonable extend.

Keywords: Cash conversion cycle, Return on assets, Return on equity

The Impact of Ethical Fashion on Consumer Purchase Behavior: A Case Study of Youth in Kandy Urban Area.

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Ethical fashion means producing cloths under environmentally and socially beneficial way. Textile manufacturers tend to use environmentally and socially harmful methods. The research problem is not having a considerable awareness among Sri Lankans regarding these social and environmental effects. The objective of this study is to identify and analyze how the social and environmental factors influence consumers' ethical purchase decisions and it contributes to identify consumers' attitudes and to be aware about issues in the industry. Young textile consumers in Kandy urban area is the population of the study and using convenience sampling method 150 customers were extracted. A structured questionnaire with five-point Likert scale was used to collect data. There are two groups of independent variables as social and environmental aspects. Concern about sweatshops, knowledge about sweatshops, beliefs about the fashion industry in social aspect and support for socially responsible businesses are under social aspect and concern about eco-fashion, knowledge about eco-fashion, beliefs about the fashion industry in environmental aspect and support for environmental responsible businesses are under environmental aspect. The dependent variable is the textile purchasing behavior. Descriptive and inferential statistics were used in the data analysis. Analysis was done under multiple regression model under 0.05 significance level. The result revealed that consumers' concern about sweatshops, knowledge about sweatshops as well as support for environmentally responsible businesses are statistically significant, and have positive relationships with the textile purchasing behavior. Belief about fashion industry in social aspect does not have a positive impact with the purchasing behavior. Textile producing companies should improve quality of production methods to positively affected the consumers' textile purchasing behavior.

Keywords: Ethical fashion, Purchasing behavior, Textile, Youth

The Effect of Store Image, Brand Name and Price Discounts on Purchase Intention of Consumers in Sri Lanka (Case study of Damro Company in Sri Lanka)

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This research was conducted to identify the store Image, Brand Name and the price discounts towards the purchase intention of Sri Lankan consumers. This research was conducted as a case study of Damro Furniture Company. Damro is one of leading retail furniture brand in Sri Lanka. The retail industry of Sri Lanka is in a competitive situation. This research is a descriptive, quantitative research and the research sample was 150 people from the southern and the western provinces. The survey based questionnaire was handed out to collect fresh data. The research analyzed through the spss (statistical package of social sciences). The research outcome indicates that all these three factors have positive and significant influence towards the purchase intention in the case of Sri Lanka. The p value of the brand name is 0.000, Store Image is 0.000 and the price discounts is 0.004 which means all the three factors are positive and significant towards the purchase intention.

Keywords: Brand name, Price discounts, Store image, Purchase intention

Material & Mineral Sciences

- Glass and Ceramics
- Polymer and Rubber
- Composites and Biomaterials
- Nanomaterials
- Energy Materials
- Mineral Extraction and Processing
- Mineral Value Addition and Gemmology

Extraction of Lactic Acid from Corn Kernels using *Streptococcus thermophilus* and Method Optimization

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Lactic Acid (LA) has several applications in pharmaceutical, cosmetic and polymer industries. Nowadays, the polymer industries focus on polylactic acid (PLA), which is a biodegradable polymer. LA is the monomer of PLA and it is an alpha hydroxy acid which can be synthesized by the fermentation of glucose obtained from the hydrolysis of starch. Even though there are lots of starch sources in Sri Lanka, study on LA extraction from corn starch is lacking. In present study, glucose was obtained from powdered corn kernels via hydrolysis by α-amylase. The hydrolysis was optimized by varying the stirring time (0.5-2.0 hrs.), temperature (27-57 °C) and corn starch concentration (0.25-1% w v^{-1}). The glucose concentration after the hydrolysis was measured by 3, 5-Dinitrosalicylic acid method. The highest glucose concentration was obtained having 0.75% of corn starch solution at 47 °C and 1.5 hrs. stirring time. Then glucose was fermented (37 °C, 0.5-4.5 days) using *Streptococcus thermophilus* which is a LA bacterium. Samples taken from fermenter at different time intervals were analyzed for LA by UV visible spectrophotometer at 390 nm after developing the yellow color ferric lactate using $FeCl_3$. The highest concentration of LA was obtained after 4 days of fermentation. Fermentation broth was centrifuged, and crude LA was purified using fractional distillation. The purity of the samples was investigated by FTIR spectroscopy. FTIR results of the purified product were agreed well with that of commercial LA. The characteristic peaks of LA were observed at 1722 cm^{-1} (C=O stretching), 2600–3200 cm^{-1} (O–H stretching), 1200–950 cm^{-1} (C–C and C–O stretching) and 1200 cm^{-1} (C-H, C-O, and CH_3 vibrations). In conclusion, LA was successfully extracted from Sri Lankan grown corn starch and the present method can be developed to produce LA in bulk quantities ultimately converting the LA into PLA.

Keywords: Corn starch, α-amylase, *Streptococcus thermophilus*, Lactic acid

The Incorporation of Layered Type Clay in Graphite-Clay Based Electrodes as a Property Enhancement for High-temperature Applications

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Although the recent developments in the field of graphite-clay based electrodes are mainly confined to kaolin type clays, the present study has been investigated the possibility of incorporating layered clay in the fabrication process. The fabrication of graphite-bentonite (layered clay) electrodes (cylindrical) was achieved by mixing raw materials in distilled water (graphite to bentonite ratio of 20:80, 40:60, 50:50, 60:40 and 80:20), stirring the content for 1h at 800 rpm and finally pressing the dry composite material (1.00×10^{-2} kg) under 1.03×10^{4} N ram force to obtain the electrodes with 4.00×10^{-2} m longer and 1.00×10^{-2} m in diameter, respectively. The compressed electrodes were fired at around 823 K for 1 h. The resistivity of fired electrodes was calculated subsequent to the resistance measurements. Results indicate that the electrode with 80% graphite is accounted for lowest resistivity (1.00×10^{-3} Ω m) whereas the highest resistivity for electrode containing 20% of graphite (1.10×10^{-2} Ω m). The resistivity range between the electrode with the lowest and highest amount of graphite is narrower for graphite-bentonite electrodes, unlike other graphite-clay based electrodes. It is also evident that the resistivity is abruptly decreased with the increased amount of graphite. The fired electrodes are very stable in both molten salts and aqueous solutions. A very high affinity of bentonite towards graphite is observed that further ensures stronger and homogeneous electrode matrix. The uniform composite matrix with minimum defects is accounted for a substantial electrical continuity and low resistivity across the entire electrode. The working temperature range up to 1473 K, low resistivity, electrical and mechanical stability, lightweight and durability are the key attributes of the fabricated electrode. The application of modified bentonite (conductive nanocomposites of clay) in electrode fabrication is also possible and will be achieved in the future.

Keywords: Graphite, Bentonite, Layered clay, Composite electrode, High-temperature application

Development of Polylactic Acid Incorporated Hydroxyapatite Composite for Bio-medical Applications

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Hydroxyapatite (HA) is one of the extensively used materials for bone replacements and tooth fillings because of its chemical and structural similarity to the main mineral component of human bone and teeth. However, poor mechanical properties such as load bearing ability limits the applications of pure hydroxyapatite. Developing new composite materials incorporating polymer into porous pure hydroxyapatite could significantly improve the mechanical properties of HA enabling it to be used in more load bearing applications. Polylactic acid (PLA) is a widely used biopolymer in biomedical engineering due to its excellent biocompatibility and biodegradability. In this study, we have developed a polymer-HA composite by incorporating PLA into hydroxyapatite matrix derived from Sri Lankan rock phosphate. This was done at room temperature. PLA was dissolved in dichloromethane and mixed with hydroxyapatite by constant stirring. Then the mixtures were left for drying at room temperature for 24 hrs. The developed material was then characterized by Fourier Transform Infrared (FTIR) spectroscopy, X-Ray diffraction (XRD) and Differential Scanning Calorimetry (DSC). FTIR results indicated that PLA has successfully incorporated into the HA matrix to form a stable composite. XRD spectra confirmed that the PLA-HA composite has a crystalline structure. DSC analysis showed that the developed PLA-HA composite has a higher thermal stability. The composite developed in this study has the potential of using in various biomedical applications and would bring more economic value to Sri Lankan rock phosphate.

Keywords: Hydroxyapatite, Polylactic acid, FTIR, XRD, DSC

Application of Carbon Nanotube Reinforced Concrete Admixtures as a Futuristic Construction Material: A Review

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Carbon Nanotubes (CNT) are one of the futuristic materials which was discovered by Iijima. Graphene sheets are rolled in a shape of continuous cylinders to develop CNT structure. It is classified according to the structure as single-walled and multi-walled CNT. Concrete is an admixture of cement, water, air and solid aggregates. In constructions, steel rods are used to reinforce the concrete composite since Ordinary Portland Cement (OPC) concrete has relatively weak tensile strength. This is a comprehensive review of previous researches which carried out in respective field. The major objective of utilizing CNT as a substitute for steel is to increase mechanical and other related properties of the concrete. The methodologies of all selected studies were included dispersion of a powder which consists of CNT by physical and chemical procedure and mixed it with the concrete admixture according to predetermined ratios. Literature suggest that cement, water and air ratios could occupy 25% to 40% of the mixture while sand and gravel consist the rest of 75% to 60% by weight. In laboratory scale, composite was cured under given temperatures and controlled moisture conditions. Since concrete takes 28 days to gain long term strength, tests were carried out after 4 weeks. Standard tests for mechanical strength, thermal resistance, chloride penetration resistance and water absorption were carried out. When CNT concrete composites were compared with the OPC concrete composites, the compressive strength, flexure and tensile strengths of the CNT concrete composites were observed to be increased up to 25%. Fire resistivity also shows an increment when compared with the references. Adding more CNT enhances the mechanical properties of concrete composites. Since using CNT for construction purposes are in preliminary stages, further researches should be done to find better dispersion techniques and material modifications.

Keywords: Carbon nanotubes, Composites, Construction material, Futuristic buildings

Synthesis of Calcium Carbonate Nano Particles using Citrate Method to Remove Dyes from Textile Waste Water

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Dye removal is an important aspect as textile industries produce waste water containing high amounts of textile dyes at high temperatures. Therefore purification of the textile waste water is of great importance as the treated water would be discharged into natural water streams. Using nanomaterials, dye removal has been studied and have yielded promising results. In this study, nano-sized calcium carbonate were synthesized using *Sol-gel hydrothermal citrate* method. Calcium nitrate, citric acid and sodium hydroxide were used as precursors for the method. Using different concentration of citric acid solution, selected as 0.5, 1, 1.25 and 2.5 times of the calcium nitrate solution, calcium carbonate nanoparticles were synthesized. X-ray diffraction (XRD), Scanning Electron Microscope (SEM), Fourier Transformed Infrared Spectroscopy (FT-IR), Thermo gravimetric analysis (TGA) and N_2 adsorption-desorption analysis were conducted (to characterize the synthesized nanoparticles qualitatively and quantitatively). For testing adsorption of the synthesized nanoparticles, standard methylene blue dye solutions were prepared and used. The effect of initial dye concentration, pH (7-12), temperature (35 °C, 45 °C, 55 °C) were conducted in this study. Optimum pH value and temperature for maximum dye adsorption were obtained. With increasing pH and temperature, adsorption capabilities increased significantly. Equilibrium data was well fitted with Langmuir isotherm for the effect of initial dye concentration. Adsorption data were used for kinetic studies using pseudo first order and second order rate equations. Kinetic studies conducted for pH was well fitted with pseudo second order rate equation, while the kinetic studies conducted for temperature was well fitted with pseudo first order rate equation. Considering the results, synthesized calcium carbonate nanoparticles could be used as an alternative for dye adsorption.

Keywords: Nanomaterials, Calcium carbonate, Citrate method, Adsorption

Development of ZnO Thin Films for Gas Sensing Applications

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In recent decades' gas sensing technology has become significant due to its widespread and common applications in the areas of industrial production, automotive industry, medical applications, indoor air quality supervision and environmental studies. Currently, there is an increasing interest in finding nanostructured materials to develop high performance solid-state sensors for in-house and outdoor hazardous gas monitoring. Among the available gas sensing materials, metal oxide semiconductors typically maintain a leading role owing to their high sensitivity, low cost, small dimensions and simple integration. This study, focused on developing ZnO semiconductor thin films *via* the technique of electrodeposition followed by a heat treatment for detecting LP (Liquid Petroleum) and H_2S gases. A three electrode electrolytic cell containing of 0.1 mol L^{-1} $ZnSO_4$ was used to carry out the electrodepositions. A FTO glass substrate (1×3 cm^2) was used as the working electrode against an Ag/AgCl reference electrode while using a high purity carbon rod as the counter electrode. The Zn electrodepositions were carried out in the cathodic deposition potential (CDP) range of 0.70–1.10 V and pH range of 4.0–1.0 at a temperature of 55 °C. Subsequently, samples were heat treated at 400 °C for 1 hour in order to form ZnO thin films and samples were then characterized for their crystalline structure, surface morphology and elemental composition using the techniques of X-ray diffraction spectroscopy, scanning electron microscopy and energy dispersive X-ray spectroscopy respectively. The sample grown at CDP of 0.80 V at pH of 1.5 for 20 minutes was found to have average sensitivity of 6% and 38% while exposing to LP and H_2S gases respectively for 2 minutes at 30 °C. Further, it revealed that, the sensitivity of the ZnO material could be enhanced by controlling the electrodeposition and the heat treatment conditions applied for the formation of ZnO nanomaterials.

Keywords: Gas sensing, ZnO, Electrodeposition, Thin films

Purification of Kaolin in Meetiyagoda Kaolin Deposit, Sri Lanka by Chemical Treatment for Whiteness Enhancement

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Titanium and iron impurities give deep colorations to Meetiyagoda kaolin. Due to these colorations Meetiyagoda kaolin needs further improvements in most of the applications where the higher whiteness is necessary. The objectives of this research are to identify the impurities in Meetiyagoda kaolin, to purify the kaolin with a chemical treatment, enhance the whiteness and to study the behavior of chemicals with varying concentrations and particle sizes. X-Ray Diffraction analysis identified that rutile, goethite and graphite are containing as impurities in kaolin. Therefore, chemical treatment of potassium persulphate ($K_2S_2O_8$) followed by oxalic acid ($H_2C_2O_2$) was carried out for purifying and enhancing the whiteness of kaolin. To investigate the effect of particle size on the chemical treatment, kaolin was dried, crushed, ground, sieved and separated for five ranges of particle sizes as 1000–500, 500-250, 250-125, 125-63 and less than 63 micron. Each sample was dispersed with sodium silicate (Na_2SiO_3) and treated with potassium persulphate for 2 hrs. Reflectance Spectrophotometer analysis recorded the highest " L " value in Hunter Whiteness index for particle size less than 63 micron. After filtering, drying, crushing and sieving to 63 micron, samples were treated with 0.1 mol dm^{-3}, 0.4 mol dm^{-3} and 0.7 mol dm^{-3} oxalic acid concentrations for 2 hrs. The highest 'L' value was given by 0.7 mol dm^{-3} oxalic treated sample and maximum leaching capacity was recorded as 76.89 mg L^{-1} by Atomic Absorption Spectroscopy analysis. Fourier Transfer Infra-red analysis reveals that some amount of iron was still remaining even after the chemical treatment. However finally the chemical treatment has shown an increment of 2.01 units in L value and decrements of 0.35 units and 1.02 units in "a" and "b" values respectively. The experimental results conclude that the tested purification method can significantly improve the quality of kaolin in industrial point of view.

Keywords: Kaolin, Impurities, Whiteness enhancement

Determination of the Regional and Residual Gravity Anomalies in the Cauvery Basin, Sri Lanka

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The measured gravity field of the Earth contains two main components of short-wavelength residual anomalies and long-wavelength regional anomalies. In the petroleum industry, the most important component is the residual anomalies which correlate with shallow density variations such as sedimentary basins. The regional anomalies are caused by deeper density contrasts in the lithospheric mantle and the Asthenosphere. Usually, the residual anomalies are obtained by filtering out the regional anomalies mathematically. This study is focused to determine residual gravity of the Cauvery Basin, as the basement data is known up to a reasonable accuracy. In this study, a depth structure map of the basement in the Cauvery Basin was prepared initially using a two-way-travel time map and velocity data obtained from eight exploration wells. Depth data from selected 2D sections were used as input data for a Mathematica® program which was based on an iterative algorithm, developed to calculate the residual gravity anomaly caused by a 2D polygonal body having a density contrast with the surrounding. The difference of the calculated and the observed gravity was then used to obtain the regional gravity along the lines. A regional gravity map was created by interpolating the above data. A variation of -50 mGal to 71 mGal of the regional gravity was observed and a relatively high gravity anomaly was also observed in the central part of the basin. This may have been caused due to the crustal thinning process which occurred during the rifting phase of the basin. The residual gravity anomaly varies from about -60 mGal to 20 mGal in the region and follows the horst and graben structures. In conclusion, the authors identified undiscovered sub-basins which are related to the separations of Sri Lanka from the Gondwana supercontinent.

Keywords: Cauvery basin, Regional gravity, Residual gravity

Characterisation and Implications for Potential Environmental Applications of Montmorillonite Extracted from Clay Deposits in Murunkan, Sri Lanka

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Montmorillonite (MMT) is one of the most commonly used smectite clay as a low–cost adsorbent in water purification due to its ubiquitous nature, high cation exchange capacity, surface area and porosity. Although high purity MMT deposits are absent in Sri Lanka, MMT–rich clay can be found in arid regions such as Murunkan, Mannar. Cadmium (Cd^{2+}) is a known human carcinogenic heavy metal deemed as a high priority water pollutant by the USEPA. This study is focused on investigating the potential environmental applications of MMT as a low–cost adsorbent for the removal of Cd^{2+}. MMT was extracted using clay collected from Murunkan area by both wet and dry sieve methods. Wet sieve method resulted in higher percentage (14%) of fine clay fraction (<63 µm) compared to dry sieve method (3.8%). X–ray Diffraction and Fourier Transform Infrared Spectroscopy revealed the beneficiation of montmorillonite in <63 µm fraction and main impurities were identified as quartz and feldspar. Upon sedimentation, impurity content was minimised and montmorillonite rich portion (MMT–Ex) in <63 µm fraction was separated. The optimum adsorbent amount for effective Cd^{2+} removal was investigated by varying the amount of MMT-Ex (0.5–4 g). The adsorbent was mixed with 25 ml of Cd^{2+} solution (5 mg L^{-1}, pH 7.3) and agitated for 24 hrs at room temperature. The supernatant was separated by centrifugation and analysed using Atomic Absorption Spectroscopy. MMT–Ex resulted 98% of Cd^{2+} adsorption with a low adsorbent dose (0.5 g). Overall, this study describes effective methods to extract MMT from MMT–rich clay and shows its potential application as an economic and effective adsorbent for inorganic contaminants in wastewater treatment and environmental remediation.

Keywords: Montmorillonite, Characterisation, Water purification, Cadmium adsorption

Synthesis of $FeCl_3$-Graphite Composite from Vein Graphite via Solvothermal Method for Lithium-Ion Rechargeable Battery Applications

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Natural vein graphite is a good crystalline material with high natural purity and is used for advanced applications. Natural vein graphite has been identified as a cost effective source to produce anode material in Lithium-ion Rechargeable Batteries (LIBs). However, the electrochemical performance of anode material prepared from vein graphite has to improve further for practical LIB applications. This study focuses on synthesizing Ferric Chloride-Graphite Intercalation Compound ($FeCl_3$-GIC) via solvothermal method to enhance the Li-ion intercalation. Anhydrous Ferric chloride was used as an intercalant into graphite layers via solvothermal method at 400 $^{\circ}$C for 12 hours by using 50 mL autoclave. The X-Ray Diffraction patterns show the characteristic behavior of the graphite intercalation compound. Moreover, weaker peaks corresponding to the Fe_2O_3 and $FeCl_3$ could also be observed in the XRD pattern indicating the existence of secondary minor phases of Fe_2O_3 and $FeCl_3$ in the GICs. Scanning Electron Microscopy images evidenced for the smooth surface morphology of graphite particles after the treatment. Half-cells were assembled using the electrode fabricated from the synthesized material and Li counter electrode in an argon-filled glovebox. It shows a high specific capacity of 378 mA h g^{-1}, which is little higher than the theoretical capacity (372 mA h g^{-1} for LiC_6) during its first discharge. However, there is a high capacity loss after 25 cycles. The fading nature of this assembled battery could be due to the detrimental effect of Fe_2O_3 and unreacted $FeCl_3$. This could be minimized by carrying out the solvothermal treatment in a vacuum environment by eliminating the O_2 present inside the autoclave chamber. By doing this, the formation of Fe_2O_3 could be minimized and as the chamber pressure increases, the ability of $FeCl_3$ molecules to be intercalated into the graphite layers could be enhanced.

Keywords: Vein graphite, Solvothermal process, $FeCl_3$-GIC, Lithium-ion rechargeable battery

Upgrading of Sri Lankan Ilmenite by Ball Milling Induced Carbothermic Reduction

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Ilmenite ($FeTiO_3$) and rutile (TiO_2) are titanium bearing heavy minerals. The existence of ilmenite percentage (70-72%) is much higher than rutile percentage (8%) in the northeastern coastal area of Sri Lanka. The value of rutile is higher than ilmenite. Though there are many chemical methods for upgrading ilmenite, physical method is cost effective for Sri Lanka. This research was carried out to analyze the optimum temperature under specific conditions for upgrading ilmenite using physical method. Upgrading was carried out using magnetically separated ilmenite sample from Lanka Mineral Sands, Pulmoddai. Mixture of ilmenite and activated carbon samples were milled using planetary ball mill for one to four hour separately. Subsequently milled samples were treated with activated carbon and heated for two hours at temperature of 800 °C, 900 °C, 1000 °C, 1100 °C and 1200 °C. Crystallinity and functional groups of the treated samples were determined using X-ray diffractometer (XRD) and Fourier transform infrared (FTIR), respectively. Particle sizes of the treated samples were determined using dry sieving method. Intensity, broadness and number of titanium dioxide (TiO_2) XRD peaks in treated samples were increased with the time during the studied four hours. FTIR analysis indicates initial ilmenite contains Fe=O, Fe-O and Fe-OH stretching vibrations. The upgraded ilmenite sample contains Ti-O stretching vibrations with more broadness instead of Fe=O and Fe-OH stretching vibrations. Particle size of the four hour milled samples was laid in between 44 to 74 microns. Characterization results show that the amount of TiO_2 and their crystallinity were increased. The annealing temperature can be reduced up to 1000 °C during the studied four hours. Therefore, Sri Lankan ilmenite can be upgraded by ball milling induced carbothermic reduction.

Keywords: Upgrading, Ilmenite, Rutile, Ball milling, Carbothermic reduction

Synthesizing a Novel Paper Material from *Penicum maximum*

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Penicum maximum is an invasive grass species originated from tropical Africa. It is distributed island-wide and has become naturalized in most ecological zones, ecosystems and habitats such as disturbed forests and scrubland. It can be initiated either by seed or vegetatively from cuttings of roots or rhizomes. This research is mainly focused on utilizing *Penicum maximum* to synthesize a novel paper material. This attempt will eventually add an importance to this weed as it has become a disturbance to important plant growth in Sri Lanka. Completely dried *Penicum maximum* leaves samples of 1.25 cm size were used for the preparation of the pulp along with Sodium carbonate and prepared pulp was beated along with Beta-D- Glucopyranoside and Aluminium sulfate. Then the conversion of pulp to paper was done and finally the synthesized paper was calendered. Selected physical properties of the developed paper material such as hydrophobicity was studied while thickness, and weight of the final paper product were measured. FTIR analysis was conducted for the paper material to demonstrate that it consists of only organic molecules. Hence the produced material could be renewable and eco-friendly. According to the results it was found that the produced novel paper material was hydrophobic without any coating and the measured contact angle was 125.623°. Average thickness of the produced papers was 0.33 mm and average weight of the produced papers was 0.0156 g cm^{-2}. In conclusion, *Penicum maximum* is a good raw material for paper production. Therefore, introducing *Penicum maximum* as a novel and better raw material for paper industry will be more important to control the threats of this invasive plant and this is a one way of value addition to a waste material.

Keywords: *Penicum maximum*, Novel paper material, Hydrophobicity, Contact angle, FTIR

Mechanically Compressed Graphite-Clay Composite Electrode for High-Temperature Applications

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The graphite-clay based electrodes have been received escalating attention very recently. Graphite based electrodes typically use as an anode in high-temperature molten salt deoxidation of minerals. The major objective is to fabricate mechanically compressed electrodes using local graphite and kaolinite to improve electrical conductivity, mechanical strength, thermal stability and durability. The composites were prepared by mixing different ratios of graphite and kaolinite (20:80, 40:60, 50:50, 60:40 and 80:20) followed by continuous stirring of the content for 1 hr at the rate of 1100 rpm. The fabrication of rod-shaped electrodes (length and diameter are around 3.00×10^{-2} m and 1.00×10^{-2} m, respectively) was achieved by pressing 8.50×10^{-3} kg of composite material (under 1.03×10^{4} N ram force) using a specially designed stainless steel mould. The resistivity of electrodes was measured before and after the firing of electrodes at around 823 K for 1 hr duration. Results indicate that the fabricated electrodes are very good electrical conductors with considerably low resistivity. The resistivity of fired electrodes is lower than the unfired electrodes. The electrode containing 80% of graphite (fired electrode) is attributed to the lowest resistivity (7.80×10^{-4} Ω m) and vice versa for the electrode containing 20% of graphite (5.80×10^{-2} Ω m). It is also evident that the resistivity of fabricated electrodes is somewhat decreased exponentially with the increased amount of graphite. The fired electrodes are very stable in both molten salts and aqueous solutions over unfired electrodes that eventually failed to endure in the aqueous medium at room temperature. The fired electrodes are capable of withstanding the temperatures up to 1473 K which ensures improved thermal stability. The low resistivity, uniform matrix, higher strength, superior thermal stability, and durability are the salient features of the newly fabricated compressed graphite-kaolinite composite electrode.

Keywords: Graphite, Kaolinite, Compressed electrode, High-temperature application, Value addition

Development of Poly Urethane based Composite using Plastic Waste of PET Bottles and Agro Waste

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In general, more than 75% of the materials which are daily used by a human being are made out of polymers. But most of them are very hazardous to the environment and human health. If these polymers are recyclable at least waste problems can be mitigated. Most of the plastic products contain fillers in order to minimize the production cost. Silica is one of the commonly used filler which is mostly produced from the sand rich with silica. The silica production involves hazardous chemicals too. We found that silica can be effectively extracted from the rice husk ash using precipitation method. This silica may be used as a filler to improve the mechanical properties of the polymer. Also, we are mainly focusing to give a solution to waste management of Poly Ethylene Terephthalate (PET) based plastics and rice husk. Specifically, in this work we degrade PET waste using glycolysis method to get hydroxyl terminated-PET (h-PET) molecules that can be used as a precursor to make polyurethanes (PUs) with commercially available diisocyanates. Further, the synthesized PU is reinforced by introducing silica extracted from rice husk ash. Series of PU samples were made from varying the wt% ratio of hydroxyl terminated-PET molecules and methylene diphenyl diisocyanate (MDI). Formulated PUs were characterized using Fourier transform infrared spectroscopy (FT-IR). The optimum ratio of MDI to h-PET was found to be 1:1 which was confirmed by the results of FT-IR. Extracted silica was characterized using FT-IR, X- ray diffractometry, X-ray fluorescence spectrometry and scanning electron microscopy. Different wt% of extracted silica was incorporated to the synthesized PU. Interestingly, we found that the free diisocyanate of MDI form new chemical bonds with silanol groups present in extracted silica which was confirmed from FT-IR analysis. Thus, the enhanced mechanical properties in the composite were accounted due to the formation of well mixed silica particles in the PU matrix.

Keywords: Polyurethane, Rice husk, Silica, PET waste

Selective Removal of Iron Oxide in Sri Lankan Laterite

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Fe-rich laterite uses as the main alumina source in cement manufacturing process. The high iron content in laterite increases the limestone consumption. Therefore, this study is focused to investigate the effect of pH, temperature and sonication time for Fe removal. The Fe removal from laterite was examined along with Cd and Mn. The loss of mass on ignition (LOI), moisture, pH, elemental and mineralogical characterization of raw and treated laterite were determined by using Atomic absorption spectroscopy, X-ray diffraction (XRD) and Fourier-transform infrared instruments. The particle size (63 µm) and the solid-to-liquid ratio (1:10) were constant, for the whole experiment. The pH range was prepared using HCl acid and NaOH at 300 K for 1800 s, while the temperature and sonication time were examined with 313, 333, 353 and 373 K for 3600 s and 600, 900, 1800, 2700 and 3600 s at 300 K, respectively. The pH, moisture, and LOI of raw laterite were 5.69, 15.80% and 16.56%, separately. The Fe and Mn removal efficiencies were increased when the pH from 5 to 1 and the efficiency was negligible when pH 6-10. Cd removal efficiency was increased when pH 1-10. All elements removal efficiencies were increased 313-373 K. Fe and Mn got high efficiency at 900 s and Cd was recovered within a short time with sonication. XRD results revealed goethite, hematite and magnetite are main Fe-rich minerals. The effective pH for Fe, Cd and Mn were 1 (17.6 ppm), 7 (0.18 ppm) and 1 (2.05 ppm), respectively. The Fe and Mn removal efficiencies were greatly influenced by hydrogen ion concentration and Cd removal was influenced by hydroxyl ion concentration. The optimal condition of Fe for industrial applications is pH 1 with 333 K temperature or pH 1 with 900 s sonication time. The optimal condition for Mn is pH 1 with 900 s sonication time and Cd can dissolve effectively with basic pH conditions under high temperatures.

Keywords: Laterite, Fe removal, Cement manufacturing

Depositional Characteristics and Accumulation Model of Peaty Sediments in the Southwest Coast of Sri Lanka

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Tropical peat lands are a major terrestrial carbon sink during the Holocene, but there is considerable uncertainty in the accumulation of carbon in a changing climate. In this study, our objective was to measure baseline carbon cycling data for understanding depositional mechanism and peat accumulates in the southwest coast of Sri Lanka. Sedimentary facies were identified using a representative peat core sample (54 cm in depth) at Telwatta. Geochemical characteristics of peaty sediments were determined using proximate, X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), atomic absorption spectroscopy (AAS) analyses. Chronology was determined using accelerated mass spectrometry (AMS) ^{14}C data for a coral sample at International Chemical Analysis Inc laboratory, USA. Core log data indicate mainly clayey peat deposit under minerogenic sediments and coral fragments, suggesting an ancient buried peat land. Temporal variations of moisture (range from 1.55 to 16.89%), ash (range from 88.66 to 99.43%), and volatile (range from 6.27 to 14.03%) contents show an irregular distribution with depth. However, total organic carbon values drastically increase in the upper sedimentary succession (0-30 cm in depth, range from 2.40 to 3.58%, average = 5.23% ± 0.01) compared to lower sedimentary succession (range from 3.69 to 4.14%, average = 4.10% ± 0.01), suggesting that reduction of microbial activity and decomposition rates with the depth. The calculated humification index based on FTIR peak intensities suggests that sapric humus condition in the upper sedimentary succession (Humification Index-H1) due to plant remain easily identifiable and no amorphous material. XRD analysis indicates the calcite (26.8º) and aragonite (20.9º) phases in coral samples. Fe range from 65.24 to 212.50 ppm) element distributions in core samples suggest the development of the anoxic and acidic condition of core samples. Radiometric dating of the inland coral fragment at 23 cm in depth is 3435 cal yr B.P., reflecting inland coral formation during the middle Holocene sea-level rise over the southwest coast. In summary, southwest coast of Sri Lanka was characterized by long-term carbon sequestration after middle Holocene seawater invasion, at the rate of 0.07 mm per year under the warmest climate regimes.

Keywords: Carbon sequestration, Holocene, Sea-level changes, Tropical peat land

Investigation of the Use of Paddy Husk Silica as a Compound for Polishing Gem Minerals

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This research is focused on the use of paddy husk ash as a compound for the polishing purposes of gem materials. Most of the gemstones in the present day are polished by using diamond powder which often produces scratches and uneven surfaces on the facets on the surfaces on the facets owing to the greater hardness of the polishing medium which decreases the quality and value of the gemstones. Diamond is the hardest of all natural substances act as a cutting medium rather than a polishing medium. In this research, a spherical balls prepared by mixing paddy husk ash and cooked rice with an excess amount of water. This ball is eventually dried under the sun for four days. A special suspension medium was used to polish the gemstones with the paddy husk ash polishing agent. This polishing oil bonds the polishing powder to the polishing disk and retains the polishing powder intact during polishing. The polishing powder was embedded into a copper disk and was it used as the polishing plate. The silica based polishing paste were subjected to an XRF (X-ray Florescence) analysis to determine the elemental composition. XRF analysis shows that there were 92.1% of silica present as the major element. Remaining oxides are MgO, Al_2O_3, K_2O, SO_3, MnO and TiO_2 presents as minor elements in the sample. XRD (X-ray Diffraction) analysis shows that the bulk of the sample is amorphous. FTIR (Fourier Transform Infrared Spectroscopy) shows that the O-H, Si-OH, H-O-H and Si-O-Si bonds in the sample. Optically flat surfaces were produced when a gemstones were polished using this compound. This polishing compound has proved to be an excellent product to polish species and varieties of gems. It is an ideal substitute for diamond powder which very costly and less effective.

Keywords: Gem polish, XRF, XRD, FTIR

Enhancement of the Colour of Natural Greenish Yellow Chrysoberyl Using Heat Treatment Techniques

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Sri Lanka is one of the greatest gem sources and trading place in the world and has a rich, almost unparalleled tradition and remains vitally important to the global gemstone market. Chrysoberyl ($BeAl_2O_4$) is a variety of gemstone which is predominantly greenish, yellow, yellowish green, brown or rarely green in colour. The most common colour of chrysoberyl in Sri Lanka is transparent greenish yellow which less appealing than the yellowish green colour. The exposure of a gem to high temperatures for the purpose of altering its colour and/or clarity was a common practice for centuries and research on chrysoberyl seldom carried out in Sri Lanka. Thus, the study based on heat treatment of chrysoberyl in order to enhance the colour and the clarity. 10 samples were collected from Ratnapura, Eheliyagoda and Rakwana area and samples were cut into two pieces along C axis (Optic axis) using a lapidary sawing machine. Heat treatment was done in both oxidizing and reducing atmospheric conditions and by varying the temperatures from 700 °C to 1200 °C, with the soaking time of 15 minutes to 2 hours. Untreated and treated stones were analyzed using Raman spectroscopy. Best colour and clarity enhancement were obtained when treating the stones under reducing atmosphere and greenish yellow colour chrysoberyls transformed into an apple green colour. Furthermore, with the increase in temperature, the colour change from greenish yellow to light green appeared more dominantly. In prospect of clarity during the heat treatment got enhanced the clarity by dissolving the colloidal impurities inside the stone. The greenish yellow chrysoberyl which has an unappealing colour could be converted into a more desirable green colour under reducing condition with the maximum temperature of 1200 °C. Raman spectroscopy has indicated peaks at 100 cm^{-1}, 400 cm^{-1} due to OH bond stretching. Analyzing the Raman spectroscopy of the heat treated Chrysoberyl samples, some peaks got increase and some peaks got decrease significantly. Therefore, the Raman spectroscopy could use to identify the heated chrysoberyls from the unheated.

Keywords: Chrysoberyl, Raman spectroscopy, Heat treatment

Detail Investigation on Gamma Ray Irradiated Sri Lankan Yellow Sapphire

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The intensity of colour of yellow sapphires play a key role in estimating its value. Therefore, different treatment techniques are practiced to improve the yellow colour of sapphires. Among them heat treatment and gamma ray irradiation are the main techniques performed in Sri Lanka. However, scientific studies on gamma ray irradiated yellow sapphire is limited. Thus, in this research, spectroscopic investigation was carried out on irradiated Sri Lankan yellow sapphires. Twenty pale yellow sapphire samples were collected from Ratnapura area and 10 samples were exposed to gamma irradiation. Secondary radioactivity of the irradiated samples was tested using Digital Geiger Muller Counter. Colour stability test was carried out by exposing them to direct sunlight and shortwave ultraviolet light. Colour changes were evaluated using GIA® Colour grading tool and spectroscopic tests of UV-visible, Raman and FTIR were also performed. Results of radioactivity test showed that the radiation levels to be 19.25 CPM (counts per mints) for natural and 19.35 CPM for irradiated samples within 20 min and these levels are not hazardous to humans. However, the irradiation has improved the yellow colour. The colour developed due to gamma ray irradiation was stable under the UV light but, it turned into its original colour under the sunlight within 30 min. The UV-visible and FTIR spectrums of irradiated and control samples showed typical absorption patterns for natural yellow sapphires. Raman spectrums of control and irradiated samples also showed typical absorption spectra corresponding to Al-O. The intensities of all peaks (410, 895 and 1040 cm^{-1}) are comparatively higher in irradiated samples and the irradiated samples showed new peaks in 380 and 640 cm^{-1}. This may possibly be due to slight deformation of the lattice when exposed to gamma irradiation. In conclusion, the irradiated yellow sapphires do not emit harmful radiation and the colour developed is not stable.

Keywords: Yellow sapphire, Raman spectroscopy, FTIR, Irradiation

Influence of Partial Replacement of Carbon Black with Areca Nut Husk Fiber on Properties of Natural Rubber Composites

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Development of Natural Rubber (NR) composites using natural fibers (NF) such as coconut, bamboo, banana, sisal, etc. has been increased during the recent past due to the growing need for green rubber composites. NF are low density and low cost materials having high recyclability and biodegradability. However, compatibility between NF and NR is not adequate to achieve properties required for various applications. Areca nut husk is one of the good sources of NF which is abundantly present as a waste. One series of composite was prepared with six NR composites using carbon black (N 330) and surface treated (with silane coupling agent) Areca nut husk fibre (SAF) by varying the SAF loading from 0 to 50 phr at 10 phr intervals, whilst maintaining the total filler loading at 60 phr. Another series with six NR composites was also prepared using the same formulation, but with untreated Areca nut husk fibre (UAF). UAF and SAF composites were characterized using Fourier Transform Infrared Spectroscopy (FTIR). Cure characteristics and physico-mechanical properties of these composites were tested to select the best ratio of the two filler materials in terms of properties for low cost applications. Cure rate decreased, however scorch safety improved with the increase of the amount of SAF in the composite. Hardness, tensile strength and tear strength decreased, whilst resilience, abrasion weight loss and compression set increased with the increase of SAF loading. Results indicated that two third of the carbon black in NR composites could be replaced with SAF without a significant effect to the properties.

Keywords: Areca nut husk fiber, Natural rubber, NR composites, Reinforcement of rubber, Surface treated fiber

A Dual Filler System for Low Speed Tire Base Compound

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The effects of the dual filler system of Carbon Black (CB) and Chopped Tire Cord (CTC) were investigated on the mechanical properties and cure characteristics of low speed tire base compound made out of Natural Rubber (NR) and Reclaim Rubber. Chopped tire cord is a cost effective filling material which is derived from the rejected pneumatic tires. To determine the composition of materials, Thermo Gravimetric Analysis (TGA) was carried out for two CTC grades as weight percentages and the grade having high amount of CB (25%) was selected and used during the study. Compounds were prepared keeping CB to CTC ratios at 65:35, 55:45, 45:55 and 35:65 in parts per hundred parts of rubber (pphr) filler loading levels. Then curing and physico-mechanical properties were investigated according to ISO standards. Mooney viscosity of the compounds was within the accepted levels of 60-85 Mooney Units. Scorch time (T_{s2}) and optimum cure time (T_{90}) have increased due to the reduction of CB content when increasing the CTC content in the compounds. However, it has improved the processing safety of the newly developed base compound. Hardness was within the accepted levels of 87-92 (Shore A) and the tensile strength was greater than 6 MPa. Tear strength and rebound resilience have improved along with the increase of CTC content. In conclusion, it is highly possible to use CTC in Base compounds of low speed tires as a cost effective filler at 65 pphr level with improved properties because the cost of CTC is well below the cost of CB.

Keywords: Carbon black, Chopped cord, TGA, Physico-mechanical properties

Effect of Catalytic Carbon on Efficiency of Chloramine Removal

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Chlorine and chloramine are the famous disinfectants that are mostly used in water treatment applications. Due to adverse effects of chlorination, an increasing number of public water suppliers are moving from chlorine to chloramine and therefore, the latter has become an alternative disinfectant. Chloramine level less than 4 ppm is considered safe for drinking water. High concentration affects the quality of the water in terms of taste and smell while leading to health risks. Also, chloramine is a contaminant that is difficult to be removed at the point of use. Activated charcoal can be used as a solution for this issue. Because, the activated catalytic carbons has very high reaction kinetics for the removal of chloramines from drinking water given the high static and dynamic adsorption capacity. The objective of the present study was to find out the most efficient Haycarb catalytic carbon type for removing chloramines from drinking water. For this purpose, six different varieties of Haycarb catalytic carbon (HC/MCA/01, HC/MCA/02, HC/MCA/03, HC/MCA/04, HC/MCA/05 and HC/MCA/06) were tested feeding with 30 ppm chloramine solution under three different laboratory conditions (powder static adsorption test, granular static adsorption test and dynamic adsorption test). Adsorption capacity of the catalytic carbon was also calculated. According to the results, the sample HC/MCA/05 showed significantly (P<0.05) higher chloramine adsorption capacity compared to the other five samples: powder static adsorption capacity: 491 mg g^{-1}, granule static adsorption capacity: 260 mg g^{-1}, dynamic adsorption capacity: 900 mg g^{-1} at 25 Ml min^{-1} flow rate with 60s Empty Bed Contact Time. In conclusion, the sample HC/MCA/05, which is a surface modified wood based Haycarb catalytic carbon, is the best variety that can be efficiently used for removing the chloramine in drinking water.

Keywords: Chlorine, Chloramine, Activated carbon, Catalytic carbon, Drinking water

An Ionic Liquid based Gel Polymer Electrolyte for Zn / Sri Lankan Natural Graphite Rechargeable Cells

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Ionic liquids (ILs) have been identified as viable substitutes for solvents such as ethylene carbonate, propylene carbonate and diethylene carbonate which are known to be toxic in gel polymer electrolytes (GPEs). Hence, at present, they have received a great attention towards the global focus on fabricating devices using low cost, environmental friendly materials. In this study, investigations were carried out to analyze the performance of IL based GPE in a Zn/Sri Lankan natural graphite rechargeable cell. As per the literature survey, this type of cell configuration has not been reported before. GPE was prepared using the conventional solvent casting method. Poly (vinylidene fluoride–co–hexafluoropropylene), zinc trifluoro methanesulfonate and 1–ethyl–3–methyl imidazolium trifluoromethanesulfonate were used as the polymer, the salt and the IL respectively. Cell of the configuration, Zn/IL based GPE/natural graphite was characterized using Electrochemical Impedance Spectroscopy (EIS), Cyclic Voltammetry (CV) and Galvanostatic Charge Discharge (GCD) test. Open circuit voltage of the cell was about 1.0 V. This is quite sufficient for low power requirements. EIS results confirm that the GPE has a good ionic conductivity. The value of charge transfer resistance between the electrodes and the electrolyte obtained from EIS results is rather low. Cyclic voltammogramme obtained by cycling at 10 mV s^{-1} within the potential window 0.05 to 2.05 V has two reduction peaks and one oxidation peak. One reduction peak and the oxidation peak represent the movement of Zn ions. The other reduction peak is due to Zn ions. The specific charge of the cell was found to be 4.66 mA h g^{-1}. The average discharge capacity of the cell was 3.00 mA h g^{-1} as per the GCD test. Over 1000 cycles, cell showed an efficiency of 92% confirming the stability of the cell to tolerate the continuous cycling. Further improvement is needed for commercial applications.

Keywords: Ionic liquid, Natural graphite, Cyclic voltammetry

Sri Lankan Natural Rubber based Electrolyte for Electrochemical Double Layer Capacitors

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Energy storage devices have received a global interest today to satisfy the increasing thirst for power. Solid polymer electrolytes (SPEs) play an important role being the ion conduction medium between the two electrodes of those devices. One crucial problem with many SPEs is their high cost due to use of commercial polymers. Recently, natural rubber (NR) has been recognized as a very suitable substitute for such expensive polymers. As NR is an insulator, several modification methods have been adopted to make it suitable for SPEs. Main objective of the present investigation was to check the suitability of NR based SPE to be used for an EDLC. This paper reports about a SPE prepared using methyl grafted NR (MG 49) and a Li salt with tetrahydrofuran following solvent casting method. A thin, bubble free film could be obtained. Samples were prepared varying the salt concentration. Impedance data were gathered at room temperature and the ionic conductivity was calculated for each sample. For the sample that showed the highest conductivity, impedance data were collected varying the temperature. For the electrochemical double layer capacitors (EDLCs), electrodes were prepared using Sri Lankan natural graphite. Performance of EDLCs were monitored using cyclic voltammetry and galvanostatic charge discharge tests. The highest ionic conductivity at room temperature was 3.62×10^{-5} S cm^{-1} at the salt concentration of 40 wt%. Single electrode specific capacity was depending on the potential window and the scan rate use for cycling. An initial single electrode specific capacity of 0.94 F g^{-1} was observed from EDLC. It reached a value of 0.55 F g^{-1} during 500 cycles. Single electrode specific discharge capacity dropped very fast at the beginning and then was constant around 0.05 F g^{-1}. Investigations are in progress to improve the ionic conductivity of SPE and to improve the performance of EDLC.

Keywords: Natural rubber, Electrochemical double layer capacitors, Cyclic voltammetry, Galvanostatic charge discharge test

Sri Lankan Tourmaline's Inclusions and their Behaviors under the Gas Fired Heat Treatment

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Sri Lanka is famous for gemstones since ancient times. Among them, Tourmaline plays a major role in a wide range of colours. Gemstones can identify from their physical and optical properties, such as refractive index, UV spectrum and the presence of inclusions. Heat treatment is one of the most common methods to enhance the value of low-quality gem stones. Natural gemstones could differentiate from synthetics or heat treated from inclusions trapped inside and their behavioural changes. Total of thirty brown colour tourmaline samples were collected from Ratnapura area and subjected to heat treatment process under oxidation condition from 650 °C to 900 °C using "Lakmini" furnace and observed under the ×10 to ×40 magnifications before and after the heat treatment. Out of thirty samples, twenty samples contained isolated, transparent tabular shape solid crystals and clustered solid crystals. Greenish black rounded and hexagonal plate-like apatite and bi-phase (liquid-gas) inclusions were noted in three samples. When stones contain a large number of solid inclusions it could be dark, therefore clarity drops in a significant way. Crystal inclusions could help to identify heated gemstones since after the heat treatment, crystal inclusions transformed into cloudy or partially melted sugar like crystals in most instances. Some crystals melted without remaining any clue. Apart from crystal inclusions, cracks were noted in eleven samples. Cracks looked like in continuous path and it was having a high probability to melt. Feather-like trichites observed in ten samples with different shapes and sizes. Trichites in natural stones were having continuous flow but after the heat treatment it appeared as discontinuous flow. Furthermore, tiny trichites fully melted during heat treatment; therefore, trichites also could use to identify unheated tourmaline from the heat treated.

Keywords: Tourmaline, Heat treatment, Inclusions

Assessment of Geuda Heat Treatment Using Gas-fired and Electric Furnaces

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"*Geuda*" (Al_2O_3) a variety of corundum gems, has the potential of converting into Blue Sapphires through heat treatment since it contains Fe and Ti as impurities. With high temperatures, Al, Fe, Ti atoms inside the "*Geuda*" get into excited state provides possibilities to make $[FeTi]^{+6}$ complex that produces blue colour. Sri Lankan gem industry commonly adapts gas-fired furnaces for heat treading Geuda, yet recently introduced electric furnaces have also shown suitable because gas furnaces are superior to electric ones in achieving the desired colour in finished gems. However, proper investigation hasn't been done to select the most suitable heating method. This study, the color development of Geuda is investigated under different heat treatment of gas furnace, electric furnace, separately and combination of them. In addition, soaking time and heat regimes are also used to investigate the colour development. Eighteen Geuda Samples were collected from Ratnapura, Niwithigala, Lunugala and Ambalangoda areas and were cut into three equal size pieces, separately. Two pieces were heat treated while keeping the other pieces as the control. Eighteen samples were treated using the gas furnace at 1750 °C for 30 min. Also, electric furnace was used to treat the samples under different temperatures such as 1300 °C, 1500 °C and 1750 °C, separately and 18 samples were treated in each temperature while changing the soaking time such as 3, 7 and 30 days, respectively. Similarly, treated pieces under gas furnace were again treated using the electric furnace under the above conditions. Finally, color changes were analyzed using the GIA color grading system. Color of the samples treated in gas furnace at 1750 °C for 30 min is enhanced than that of the samples treated in electric furnace at 1300°C and 1500 °C temperatures. However, significant colour enhancement is obtained for the samples treated at 1750 °C for 30 days under electric furnace. The best color change is obtained for the samples treated at 1750 °C for 30 days under combine heat treatment method.

Keywords: Geuda heat treatment, Gas furnace, Electric furnace, Colour enhancement

In-situ Synthesis of Zinc Oxide Seeds on Thin Film of Mica as the Highly Reactive Photocatalyst Under UV-Light Irradiation

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Structurally layered mica has attracted much attention of the mineralogists due to its unique structural properties. This study mainly concerns in developing the nano-seeds of Zinc oxide on thin film of mica (ZnO-mica) and the potential study of the photo-catalytic property under UV-light irradiation. The ZnO-mica was prepared by the *In-situ* growth of nanoparticles. 5 g of (0.5 cm × 0.5 cm) cut thin films of mica was added to the mixture of 600 µL, 50 mL of Cetyltrimethylammonium chloride (CTAC) and 2 mol dm^{-3}, 50 mL of zinc nitrate hexahydrate. Then, $Zn(OH)_2$ seeds were grown on the thin sheets of mica by adding 4 mol dm^{-3}, 50 mL of NaOH solution with stirring for 24 hrs. The obtained product was then calcined at about 600 ℃. Finally, photo-catalytic property study was carried out in beakers containing 50 mL of Methylene Blue (MB) with various dose of (1.0, 3.0, 4.0 and 10.0 g) ZnO-mica. UV-Vis spectroscopy analysis was implemented with 30 min of time interval under the UV-light irradiation with initializing under dark condition for 30 min to 3.5 hrs. The synthesized final product was characterized by using the characterizing techniques such as X-ray powder diffraction and scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), Fourier transform infrared spectroscopy and thermo gravimetric analysis. The analytical data from the SEM reveal that the synthesized product with flower-like morphology having average particle length and width are 800 nm and 50 nm respectively. The crystallinity and the chemical analysis using XRD and FT-IR confirm the presence of ZnO on mica. The plot of percentage dye degradation versus time with increasing dosage under UV light indicates the rapid photo-catalytic dye degradation with increasing dosage of the photo-catalyst. The simple, flexible and novel method has been devised to develop the photo-catalyst under the UV-light irradiation.

Keywords: Zinc oxide seeds on thin film of mica, *In-situ* growth, Photo-catalyst, Flower-like nanoparticles, Dye degradation

Synthetic Dyes as Photosensitizers for Dye Sensitized Solar Cells: A Comparative Study

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The dye is an essential component of the Dye Sensitized Solar Cells (DSSC) and methods to improve the efficiency of DSSCs have been investigated over the last two decades. The most successful synthetic dyes are based on ruthenium complexes. However, ruthenium based compounds are relatively expensive. Finding more economical synthetic organic dyes with comparable characteristics of ruthenium is therefore beneficial. In the present study, six different organic dyes namely 1,10-Phenonthroline, Dimethyl yellow, Bromocresol purple, Alizarin red, Chlorophenol red and Cresol red were selected as sensitizers. Nanostructured TiO_2 films were dipped in ethanolic solutions of each dye for 24 hours and DSSCs were assembled with the configuration of FTO/TiO_2/electrolyte/Pt counter electrode. A liquid electrolyte composed of Tetrapropylammonium iodide ($Pr4N^+I^-$), Iodine (I_2), Ethylene carbonate and acetonitrile with optimized composition was employed as the electrolyte. Conversion efficiency of the fabricated DSSCs was tested under the illumination of 100 mW cm^{-2}. The highest overall conversion efficiency of 0.421% with 60% of fill factor was obtained for the dye sensitized solar cells sensitized with Alizarin red. Further investigations on structural modifications of Alizarin red will be studied in order to enhance the efficiency of DSSCs.

Keywords: Photosensitizers, Synthetic dyes, Dye sensitized solar cells

Application of Geology and GIS in the Exploration of Gem Deposits in Haldumulla Divisional Secretariat Division, Badulla District, Sri Lanka

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Sri Lanka has a very long history for gem industry. Geologically, ninety percent of the Sri Lankan rocks are high grade metamorphic type and higher percentage of them has attributed for many of the gem deposits. These gem minerals are found as either primary or secondary deposits. Application of GIS based analysis and predictions of mineral potential areas have attracted huge attention for its versatility of mapping and making predictions of mineral potential areas. Haldumulla Divisional Secretariat in Badulla District was selected as the study area covering 39 GN divisions and 183 villages. This area lies on both Highland and Vijayan complexes and chiefly underlain by Biotite Hornblende Gneiss, Marble, Chanockitic Biotite Gneiss, Charnockitic Gneiss, Garnet Sillimanite Biotite Gneiss and Quartzite. In addition, geological structures like Bintenna Synform, Koslanda Fault and Shear zones were identified within the area. Based on field experience and literature, eight parameters were recognized as causative influences for occurrences of gem deposits, namely; geology, mineralogy, distance to geological structures, distance to internal drainage system, elevation, slope, paddy area, and flood area. Distribution of each factor within the study area was obtained as raster layers (referred to as factor maps). Overlay Method and Weights of Evidence Method (WOE) were used to integrate the factor maps to produce a gem potential map in GIS environment. Kotabakma gem field, Gampha gem field, Weli oya gem field and Nikapotha gem field were identified as high gem potential areas in the area studied. Confirmatory field visits on selected areas of the identified gem fields were made to confirm the information on the map. The final gem potential map will help gem miners to extract gem deposit in Haldumulla DS area and it will upgrade gem industry in Sri Lanka.

Keywords: Gem minerals, Raster layers, Factor maps, Geological structures, Gem potential Map, Haldumulla

Introducing a Simple Heat Treatment Method for Natural Topaz in Matale as an Alternative to the Irradiation

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Most of the Topaz found in Sri Lanka has low commercial value due to their yellow to colourless appearance. The pale colour Topaz can be converted in to blue by irradiation and it is stable at ambient or normal temperature and light. After the irradiation atoms become radioactive whenever there is an excess of energy in their nuclei. This radioactivity generates gamma radiation which can course health problems for those who wear them. Therefore, some countries have issued acceptable radiation level for handling irradiated Topaz. However, Sri Lankan government's policies on the handling and distribution of radioactive irradiated Topaz to the public are still in infancy. This study is conducted to analyses the radioactivity of irradiated Topaz and to introduce a law cost simple harmless heat treatment method for colour enhancement of Topaz. Natural and irradiated Topaz of Polwatta was analyzed using gamma ray emission detector and radionuclides were identified using Gamma Spectrometry measurements. Mineralogical constituents and composition were confirmed by X-ray diffraction and Energy Dispersive X-ray Fluorescence. Natural topaz samples were subjected to heat treatment and exposure the treatment of temperature ranging 430 °C to 440 °C using electric furnace. Based on the results natural Topaz contained chromium (Cr) Thorium and Uranium series isotopes of ^{212}Pb, ^{214}Pb, ^{214}Bi, ^{228}Ac, ^{40}K and ^{208}Tl other than Al. After the irradiation process long levied radionuclides, ^{182}Ta, ^{88}Kr and ^{46}Sc were generated. Radioactivity of the irradiated samples is high with compared to the natural samples. The reported dose rate of irradiated Topaz was 107.34 mS v h^{-1}. It was able to obtain Pinky color by heat treatment of pale yellow Topaz. This was due to the presence of chromium in trace amount and it has been incorporated in to the crystal structure during the heating process in brown stones.

Keywords: Topaz, Thorium series, Uranium series, Heat treatment, Radioactive

Gem Trader's Perception on Treatment of Low Gem Quality Minerals, Ratnapura, Sri Lanka

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Enhance the quality of low-quality gem minerals and materials have become vital to fulfill the current market demand in the world. Gem traders in Sri Lanka are mainly focus their treatment on *Geuda* varieties. Nevertheless, different types of low gem quality minerals are remaining as untapped gem resources in Sri Lanka and have a potential to enhance the quality using various methods like waxing, oiling, bleaching, fracture or cavity filling. Thus, initiation of new research on treatment of low gem quality minerals is a paramount importance in Sri Lankan gem industry. The main objective of the study was to identify the availability of low gem quality minerals and the gem traders' perception on that. Information on gem traders' role, awareness on gem treatment, information of low-quality gem minerals and abundance of different gem types in the market, were gathered by interviewing hundred gem traders in Rathnapura area, through a structured questionnaire survey. Results clearly showed that 77% of the gem traders in the area vend their gemstones without any value addition process while 15% of respondents were directed heat treatment to enhance gemstones before retail. Although 79% of the respondents were given positive responses about awareness on heat treatment, they were only aware on *Geuda* heat treatment. Frequently found most valuable gem types belonged to corundum family and they have high demand. 60% of respondent's declared spinel as a low gem quality gem type in the market while topaz also available in significant quantities. Subsequently, results clearly revealed that even though traders have awareness on heat treatment of gemstones, only a few of them perform heat treatment. Since, heat treatable low gem quality gemstones like spinel and topaz are frequently found in the area research on treatment of spinel and topaz are very important to maximize the profits in the gem industry.

Keywords: Geuda, Spinel and topaz, Heat treatment, Gem trade

Geochemical Exploration of Negombo Lagoon Sediments in Western Coast of Sri Lanka

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Negombo Lagoon is one of the largest lagoons in Sri Lanka, and it is surrounded by Muthurajawela peat deposit. Geochemical characteristics of sediments were examined using proximate, X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), atomic absorption spectroscopy (AAS) analyses. Chronology was determined using accelerated mass spectrometry (AMS) ^{14}C data for undamaged two shells at International Chemical Analysis Inc laboratory, USA. Stratigraphic observation suggests deposition of dark color sandy/silty clays. Moisture, volatile, ash and organic matter contents show homogeneous distribution with depth. XRD analysis identified mainly peaks of Quartz, Calcite, Feldspar, Beryllium Carbide (Be_2C), Lanthanum Palladium, suggesting that different provenances for the source materials. FTIR analysis identifies mainly functional groups of C-H, O-H, C=C, C=O, Si-O and C-O probably from carboxylic acid, alcohol, aliphatic hydrocarbons and polysaccharides, suggesting that the early stage diagenesis in this natural system. Fe (range from 30.98 ppm to 31.79 ppm), Cr (range from 0.055 ppm to 1.381 ppm) and Rb (range from 0 ppm to 0.323 ppm) elements distributions in core samples suggest the increment of the anoxic and acidic conditions. Therefore, organic matter preservation can be enhanced by slow decomposition rates in deeper anoxic layer. According to radiometric dating, the undamaged shells at 45 cm and 57 cm in depth were deposited after 1950. Therefore, it suggests that higher short-term carbon accumulation rates (sedimentation rate > 8.4 mm per year) in this estuary. Finally, Negombo Lagoon can be identified as represent important carbon stores, and are important archives of past climatic and ecological information.

Keywords: Tropical lake sediment, Carbon accumulation, Estuarine peat, Anaerobic carbon cycling

Antibacterial Activity of Silver Deposited Vein Graphite Against Waterborne Pathogenic *Escherichia coli* Synthesized by Chemical Reduction Method

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Graphite is one of the common materials using for the fabrication of composite materials. Graphite oxide, graphene oxide and many other materials are used as effective antibacterial substances, but most of them are expensive and need highly toxic chemicals for the synthesis. Nowadays, silver is considered as a most effective antibacterial material. Therefore, this study was focused on synthesizing cost effective less hazardous antibacterial material using silver and graphite. Graphite sample was purified by acid leaching, followed by modifying the surface with Conc. HNO_3. The silver graphite composite material was synthesized using $AgNO_3$ as precursor and tri-sodium citrate as reducing agent. X-ray diffractometry and Scanning electron microscopy investigations of the synthesized silver graphite composite revealed that the pure crystalline nano silver particles were deposited on the graphite surface. Antibacterial efficacy of the synthesized material was investigated using waterborne pathogenic *Escherichia coli*. The antibacterial test was carried out against *E. coli* using prepared composite samples according to the shake flask test. A commercial antibiotic (Ofloxin-200 mg) was used as the positive control. The samples were drawn at times 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 5 and 6 hours by counting the number of surviving bacterial colonies on Eosin Methylene Blue (EMB) Agar, using plate count method according to standard procedures. After 24 hours, the results showed that surviving bacterial colonies contained in counted petri plates of all the synthesized composites with different Ag: Graphite ratios were reduced, with the time in an efficiency of over 98%. Therefore, this study suggests that Ag-vein graphite composite synthesized via chemical reduction method can be effectively used as an antibacterial agent against *E. coli.*

Keywords: Graphite, Silver, Composite material, Antibacterial testing

Characterisation of *"Dummala"* Origin in Sri Lanka by XRF, XRD and FTIR

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The term *Dummala* is a traditional name given to the naturally occurring substance that can be found, either at uppermost crustal levels, mostly under the freshwater swampy areas or as a dried resin like gums from the *Dummala* tree (*Shorea oblongifolia)*, which is endemic to Sri Lanka. The history of *Dummala* is dated back to more than 2000 years, where it was used in ayurvedic medication and to make flares in exorcisms and processions. *Dummala* which is taken out from ground, physically appears as peat-like carbonaceous matter with agglomerated coarse-grained particles. Though, this variety of *Dummala* is naturally occurring material found in Sri Lanka a firm scientific analysis has not yet been conducted. Therefore, this study aims to characterise the *Dummala* extracted from the ground, in order to investigate the chemical composition and special properties that might be suitable for the advanced applications. Initially, natural *Dummala* was dried and 50 g of sample (<53 µm) was obtained by mechanical sieving. X-Ray Fluorescence (XRF) spectroscopic analysis were conducted to identify the chemical composition. Further, *Dummala* was characterised with X-Ray Diffraction (XRD) analysis for the phase identification and the results showed that this material is partially crystalline. XRF data together with XRD analysis confirmed that *Dummala* which is taken out from the ground is composed mainly with Magnesium Carbonate, Silica and Sulphur. Further, the present study suggests a carbon content analysis in order to interpret the origin of *Dummala*.

Keywords: Dummala, Magnesium, Silica

Geochemical Characterization of Magnetite Ore Deposit in Buttala, Sri Lanka

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Sri Lanka comprises of a fairly large number of valuable mineral deposits. However, most of these deposits have not yet been scientifically investigated, in terms of their origin, grade, mineralogy, quality and the quantity. Iron ore deposits of Sri Lanka are divided into three categories as magnetite deposits, hydrated iron oxide deposits and copper-magnetite type deposits. The largest magnetite deposit of the country is located at Palawatte, Buttala in Uva province. The origin, quality and the quantity of the Buttala magnetite deposit (BMD) is still debatable. Therefore, present study focused to interpret the geochemical characteristics in order to predict the possible sources for the origin of BMD. Rock samples were collected from the pre-determined locations in BMD area. Representative magnetite bearing rock samples and country rock samples were collected mainly from fresh outcrops available at the surface. A detailed geochemical analysis was conducted by X-ray fluorescence (XRF) spectroscopy. The results of major oxides indicated high content of iron (>80%) with minor amounts of SiO_2 (7.02%), Al_2O_3 (5.98%), TiO_2 (3.22%), MgO (2.82%), K_2O (0.22%), CaO (0.12%) and MnO (0.08%). The spatial distribution plots of trace elements and major elements indicate the mineralization is localized to the hummock of the study area. The depleted concentrations of elements such as Ti and Zr that are considered relatively immobile in hydrothermal fluids suggests the involvement of hydrothermal processes to the formation of BMD. Further, it is recommended a detailed petrographic analysis in order to confirm the hydrothermal origin of the BMD.

*Keywords***:** Buttala iron ore, Geochemical, Hydrothermal

Substitution of Rice Husk Ash for Grout Additive to Decrease Shrinkage of Cement Grouting

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Rice husks are the protecting covering of grains of rice. They are formed from hard materials, including opaline silica and lignin, to protect the seed during the growing season. Rice milling industry generates substantial amounts of rice husk during milling of paddy, which is mostly used as a fuel in rice milling industry. Rice Husk Ash (RHA) is about 25% by weight of rice husk when burnt in boilers. Chemicals used in grouting may be replaceable with waste material from the rice milling industry when it is processed to RHA to decrease the shrinkage while increasing the strength. This study aims to substitute RHA as a grout additive in cement grouting and identify an optimum amount of RHA. First rice husk was burnt in a muffle furnace under controlled temperature which started at room temperature and was gradually increased up to 680 ℃ for about 6 hrs before it was allowed to cool down to room temperature (25 ℃). RHA sample was sieved by using 150 µm sieve. The cement: grout additive: water mixing ratio 2000:9:840 respectively. Then RHA was added replacing varying amounts of grout additive. The grout mixture was prepared manually by hand since the samples were too small to mix using a mixing machine. The proto type samples made were passed the strength tests according to the British Standard 1881. Mixing with a mixer would decrease the variation of results. According to the compressive strength, samples which contain high rice husk ash content were having a high compressive strength. Furthermore, the strength increased after 28 days was 49 MPa. Thus, the conclusion can be drawn that substitution of RHA for grout additive is possible and positive with gained strength.

Keywords: Shrinkage, Grouting, Grout additive, Rice husk ash

Identification of Heat Treated Natural Blue Spinel Using Raman Spectroscopy

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Sri Lanka is well known to the world for its vast potential of gem minerals. It is known in the ancient times as "Rathna Dhweepa"– "The Island of Gems". Almost 75% of the landmass of Sri Lanka is composed of ancient gem-bearing rocks. Sri Lanka produces more than 75 species and varieties of gem minerals. The gem mineral Spinel is found in greater abundance in Sri Lanka as compared to other gem minerals. Most of the naturally occurring blue spinel is dark blue in color. These dark blue spinels have no demand and have a very low market price. Therefore, this study was focused on heat treatment of this low value material, under specific temperatures and atmospheric conditions for certain durations to reduce its color intensity, dissolve colloids and develop methods to identify treated stones from untreated natural stones. Samples of dark blue spinels were heat treated under both reducing and oxidizing atmospheric conditions at a temperature ranging from 600 °C to 1200 °C for 20 minutes to 2 hours. Both treated and untreated samples were then analyzed using Raman Spectroscopy. When the spinels were treated under reducing conditions no changes were observed. Color reduction and clarity enhancement were observed when the stones were treated under oxidizing atmosphere conditions. Dark blue spinel turned into greyish blue in colour with enhanced clarity. Heat treated spinels could be easily identified by Raman Spectroscopy by the width of the 405 m-2 Raman line. A wider and less intense peak could be observed for treated stones whereas in untreated stones a sharp peak of greater intensity could be observed. The results of this research have proved that dark blue spinels could be lightened and clarified by low temperature heat treatment and identification of treated stones from untreated stones could be done by analyzing through Raman Spectroscopy.

Keywords: Blue spinel, Spinel, Heat treatment, Raman spectroscopy

Transport Properties and Interactions of Ionic Liquid Doped Bio Polymer based Gel Electrolyte for Sodium Rechargeable Batteries

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The interest in gel polymer electrolytes (GPEs) as electrolyte materials for rechargeable thin film batteries has boosted in the last years. In general, different synthetic polymers are used in gel electrolyte preparation, the reports on biodegradable polymers are lacking. In this work, a gel electrolyte was prepared by solvent casting method using $NaClO_4$ salt and commercially available biopolymer i.e. agar which is extracted from marine algae. The effect of addition of an ionic liquid (IL) in this parent electrolyte was investigated using *N-Butyl-N-methylpyrrolidinium bis(triflouromethylsulfonyl)imide* ($PyR_{14}TFSI$). The IL incorporated membranes were transparent, freestanding and flexible. The ionic conductivity of the membranes was obtained using complex impedance spectroscopy whereas the polymer-salt and polymer-IL interactions were investigated using FT-IR spectroscopy. The crystallinity of the electrolytes was investigated by XRD. Our results show that the maximum ionic conductivity of 5.51×10^{-4} S cm^{-1} at room temperature can be obtained with the electrolyte having 12 wt% of $NaClO_4$ without IL. The incorporation of 10 wt% of the $PyR_{14}TFSI$ into this parent electrolyte shows further enhancement in ionic conductivity up to 1.03×10^{-3} S cm^{-1} at room temperature. FTIR results show weak but noticeable changes due to the interactions of IL with the polymer. The reduction of crystalline phases and increase of amorphous nature with the IL is revealed that the IL has a major influence on the transport properties of the electrolyte due to structural modifications associated with the polymer host and also due to the reduction of Na^+ ion and polymer coordination in the IL incorporated electrolyte.

Keywords: Gel polymer electrolyte, Bio polymer, Agar, Ionic conductivity

Gravity Separation Method for Purification of Below 2 mm Graphite Particles in *Kahatagaha* Graphite Mine

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Kahatagaha graphite mine is one of the leading graphite mines in Sri Lanka. It produces high-quality vein graphite with a carbon grade over 90%. It is considered as one of the highest-grade vein graphite mine in the world. Pyrite, quartz, chalcopyrite, feldspar are the main associate minerals with vein graphite in *Kahatagaha* mine. Extraction of graphite involves drilling and blasting. Therefore, graphite gets diluted with host rock particles and associate minerals. Extracted graphite is crushed and over size lumps are hand sorted according to carbon grade. Undersize fraction remains unsorted due to the small particle size and crushed to 2 mm size. This fraction is mixed with gangues and further beneficiation is required to remove gangues. Gravity separation methods are considered environmentally friendly and cost-effective over the froth flotation method. Therefore, in this research Wilfley Table and Denver Jig were used as gravity separation techniques to purify below 2 mm size crushed graphite particles. Feed rates, table angles and particle sizes were taken as parameters for Wilfley Table while wash water rate and reciprocating motion keeping constant throughout the experiment. Jigging duration and particle sizes were taken as parameters for jigging while sample amount is keeping constant throughout the experiment. Results show the crushed graphite fraction of 2.0-0.5 mm size range can be upgraded up to 99.5% from initial grade of 85.3% with feed rates of 8.33 g s^{-1} and 4.17 g s^{-1}, table angle of 5° with Wilfley table method. Denver jigging upgraded the carbon content of 2.0-0.5 mm size graphite up to 97.1% but separation is uncertain with the jigging duration. Results concluded that upgrading the carbon content of 2.0-0.5 mm size graphite is possible with both gravity separation methods used in this experiment and Wilfley table method produces the highest efficiency and grade with optimum conditions.

Keywords: Gravity separation, Graphite, Wilfley table

Preparation and Characterization of Copper and Sulfur Co-Doped Titanium Dioxide Nano Particles as an Enhanced Photocatalytic Material

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Photocatalyst is a substance, which can modify the rate of the chemical reaction using light irradiation. Among the various oxide semiconductor photocatalyst, Titanium Dioxide (TiO_2) has become the most important material due to its high chemical stability, non-toxicity, inexpensiveness and efficient photoactivity. However, due to its wide bandgap and the fast recombination of electron-hole pair, it has contributed to the inability to use the sunlight sufficiently as well as hindering for any reaction to happen. To utilize visible light more efficiently in photocatalytic reactions, Copper and Sulfur co-doped anatase phase TiO_2 nanoparticles with different ratios were prepared by a sol-gel method via a precursor solution of titanium isopropoxide. The powder X ray diffraction pattern confirmed that all the synthesized pure and doped TiO_2 nanoparticles samples were polycrystalline of anatase phase. Ti-O bonds in the samples were confirmed through furrier transform infrared spectrum. The average particle size determination and elemental analyses were done by scanning electron microscopy coupled with energy dispersive x-ray spectroscopy. The photocatalytic activity of the synthesized catalysts were investigated against degradation of methylene blue solution under visible light using UV-visible spectroscopic techniques. The optimal photocatalytic activity was obtained at the 100:0.25:0.25 Ti^{4+}: Cu^{+}:S^{2-} molar ratio. Photocatalytic properties were further improved by doping with $CaCO_3$ to reduce the carrier recombination. The performance was optimized at 100:0.25:0.25:0.25 Ti^{4+}: Cu^{+}: S^{2-}: Ca^{2+} molar ratio. The experimental work conducted here revealed promising results for improving the performance of the TiO_2 nanomaterial by doping it with copper and sulfur where the photocatalytic activity was enhanced and shifted to the visible region causing an appreciable increase in its effectiveness for photocatalytic applications.

Keywords: Titanium dioxide, Co-doping, Photocatalyst

Effect of Seed Layer on Opto-Electronic Properties of CdS Thin Film

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Among different methods used to grow CdS films, chemical bath deposition (CBD) and electrochemical deposition (ED) are two of the most commonly used techniques. A novel method of growing chemical bath deposited CdS thin films (CBD-CdS) by using electrodeposited CdS (ED-CdS) as a seed layer is reported and compared with conventional ED-CdS and CBD-CdS films in this work. Conventional ED-CdS films were deposited for a duration of 60 min under potentiostatic conditions of -600 mV against the Ag/AgCl electrode at a bath temperature of 60 °C in a reaction solution of 0.05 mol dm^{-3} cadmium chloride, 0.05 mol dm^{-3} sodium thiosulfate and diluted H_2SO_4. Conventional CBD-CdS films were grown using 0.001 mol dm^{-3} cadmium sulfate, 0.002 mol dm^{-3} thiourea and 1.1 ml of ammonia solution for a period of 60 min. The seed-assisted CBD-CdS films (ED/CBD-CdS) were grown by depositing CBD-CdS on top on an ED-CdS layer deposited for 3 min under the same conditions mentioned above. When compared, the ED/CBD-CdS system showed superior I_{SC} (19.4 µA) performance in PEC cell (CdS/0.1 mol dm^{-3} $Na_2S_2O_3$/Pt) compared to other two systems due to its homogeneity, enhanced majority carrier concentration, high surface roughness, and improved inter-particle connections. The ED/CBD-CdS system also showed a significant improvement in V_{OC} (198 mV) over CBD-CdS (169 mV) and ED-CdS (168 mV) systems potentially due to higher flat band potential. Additionally, comparatively high E_g value of 2.45 eV was obtained for the ED/CBD-CdS due to lower disorder value of ED/CBD-CdS system. These results suggest that the novel method of CdS deposition, seed assisted CBD-CdS thin films demonstrate better opto-electronic properties compared to both ED-CdS and CBD-CdS films alone.

Keywords: CdS, Chemical bath deposition, Electrodeposition, Seed

Determination of Optimum Antioxidant Ratio for Effective Resistance on Aging of Natural Rubber based Solid Tire Tread Compound

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Antioxidants are highly effective ingredients and have a dramatic impact on the service life of the rubber product although being present at extremely low concentrations. Dosage of these chemicals depends upon the end application. The purpose of this research was to find out the optimum antioxidant ratio for effective resistance on thermo-oxidative aging of natural rubber based solid tire tread compound. Five tread compounds were prepared by varying the n-(1,3-dimethylbutyl)-n'-phenyl-p-phenylenediamine (6ppd) and 2,2,4-Trimethyl-1,2-dihydroquinoline (TMQ) antioxidant (AO) ratios (AO_1-AO free, AO_2 - 2:1, AO_3 - 1.5:1.5, AO_4-1:2, AO_5-2:2). AO_5 was designed to test the effect of over dosage of antioxidants. Physio-mechanical properties such as tensile properties, tear strength, hardness, and abrasion resistance of five compounds were investigated before and after thermo-oxidative aging at temperature 70 ℃ for 72 hours according to the ASTM standards. Density and rebound resilience of five compounds were also investigated. According to the results obtained, percentage changing hardness, tensile strength, elongation at break and tear strength of AO_1, AO_2, AO_3, AO_4 and AO_5 were (1%, 4.34%, 1.73%, 15.70%), (2%, 3.72%, 7.94%, -4.48%), (2%, 5.27%, 11.59%, 21.64%), (1%, 1.40%, 5.52%, 3.57%) and (2%, 3.99%, 1.60%, 14.19%) respectively after aging 72 hours. Hardness, modulus at 300% and abrasion resistance increases as the heat-aging time increases. The rate of decrease of tensile strength, tear strength and elongation at break was higher after aging. Result obtained for rebound was 44%, 46%, 47%, 46% and 48% respectively. Density of all five compounds were same. In conclusion as the percentage changing was minimum in AO_4 and it is the best among five ratios under 72 hours aging condition.

Keywords: Antioxidant, Hardness, Natural rubber, Tensile properties, Thermal-aging

Effect of Carboxy Methyl Cellulose on Viscosity of NBR

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Organic Sodium Carboxy Methyl Cellulose (CMC) is a water-soluble cellulose ether and macro molecule electrolyte. CMC is versatile in its ability to control rheology and viscosity of aqueous systems. CMC also has micro foam effect and it gives the deer skin property and smoothness to the glove surface. Therefore, the aim of this study is to examine the effect of CMC on viscosity of NBR. Solidified CMC samples were used in the experiment. CMC were mixed with cure pack. In the mixture, 65% of mixture was CMC and 23% of the mixture was cure pack. The remaining 12% was water. The mixture was added to the nitrile compounds which were prepared according to the same formulation by using different treatments such as T0-control treatment with no mixture, T1-115 g of mixture, T2-86.25 g of mixture, T3-57.5 g of mixture, T4-28.75 g of mixture. Each treatment was replicated three times. After 8 hours mixing time the viscosity of the compound was measured once in each 2 hours for 7 days. Viscosity was measured using RV viscometer using spindle 3 at 20 rpm. The total solid content of the all samples were adjusted after 12 hrs. The results of the study revealed that, the standard viscosity was given within 6 hours and there was a gradual increment of viscosity with the time initially and then the viscosity was stable. The tested treatments showed different stabilizing times and decreasing viscosities with the time. Further, in the control treatment, there was only a viscosity increment and there was no plateau development. Therefore, the viscosity of the compound has been affected and the mixing time could be decreased with the addition of CMC which will be more effective in rubber industry.

Keywords: CMC, Mixing time, NBR, Viscosity

Enhancement of the Physical Properties of Natural Rubber Latex Gloves by Using Nano-Cellulose Fibrils Filler

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The growing demand for greener and biodegradable materials that brings satisfaction to society requires a convincing movement towards the advancement of nano materials science. Natural fibers are considered to have potential use as reinforcing agents in polymer composite materials due to their principle benefits: good strength and stiffness, low cost, environmental friendliness and biodegradability. Fillers are additive agents and are also functioning to improve the strength of natural rubber. This study was conducted to evaluate physical properties of natural glove made using nano natural filler of Arecanut husk (*Areca catechu*) and Bagasse (*Saccarum officinarum*) fibers, which are otherwise, throw as waste daily. In this study, we focus to determine the effectiveness of the nano cellulose fibrils as a filler for glove industry. In this work initially nano cellulose fibrils of Arecanut husk and Bagasse were prepared separately by chemically and physically. Structural analysis of Nano cellulose fibrils was done by X-Ray Diffractometer (XRD) and Fourier Transform Infrared Microscopy (FTIR). Morphological characteristics of the cellulose fibrils were observed by Scanning Electron Microscopy (SEM). Finally Nano cellulose fibrils were introduced to the natural glove compound in different amounts and natural gloves were prepared according to the specific quality standards. Then physical properties were measured according to the EN 388:2016 reference standard. The experimental and quality control results suggested that by addition of the natural filler, the abrasion, tensile strength and tear resistance properties were enhanced with compared to the synthetic filler added gloves. Overall results suggested that there is an effectiveness of nano cellulose fibrils as filler for glove industry at 0.05 level of significance.

Keywords: Nano filler, Nano cellulose, Arecanut, Bagasse, Natural Filler

Optimization of Glove Mixing Process of Gammex Powder Free (GPF) Product to Overcome Scum Formation

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Hevea brasiliensis latex is used to manufacture surgical gloves. GPF gloves are low in residual proteins and powder. Hence they are less susceptible to allergies. Scum formation is a major drawback in compounding process which contains of two major phases, phase 1 (heat prevulcanization) and phase 2 (ambient prevulcanization). The major issue of the current process is scum formation during prevulcanization stage. The main reason for scum formation is the lack of stability at elevated temperature, high dosage of ZnO which forms excessive zinc amine complexes and due to less Brownian motion of curing agents. The trials were done by changing 3 main factors such as Potassium laurate (PL) level, ZnO% and mode of cure pack. As per the trials, changed PL dosage as 50% in each phases, interchanged ZnO dosage in phase 1 (lower dosage) & phase 2 (higher dosage), individual dispersions of curing agents were introduced. Anyhow, ZnO trial was failed due to lack of ZnO for the activation of prevulcanization process. According to the statistical analysis using Minitab 16 software, the P value (<0.05) at 0.05 level of significance proved that there was an interaction between PL level and curing method. With the PL 50% in both phases and adding individual dispersions, the scum level was reduced from 8% to 0.5%. Gloves were prepared to test whether the chemical adjustment was affected for final glove quality. The P value (>0.05) at 0.05 level of significance proved that there was no significance difference in tensile strength. The modulus was more than required and it is cost effective. In conclusion, the scum formation can overcome by changing PL level and by adding individual dispersions. Furthermore, it is beneficial to overcome glove defects like scum, dirt hole and it allows opportunity for the process optimization of GPF product.

Keywords: Scum, Potassium laurate, ZnO, Individual dispersions

Preparation of Transparent Superhydrophobic Surface

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In the present study, transparent superhydrophobic films on glass substrates have been extensively investigated using a simple dip coating method at room temperature. The main objective of the present study is to fabricate a transparent superhydrophobic glass surface using a surface etching method and further modification was carried out to achieve best outcomes that is required to overcome the major drawbacks of existing superhydrophobic films. The substrates were prepared by using two different chemical etchants such as Sodium hydroxide (NaOH) and Hydrogen fluoride (HF) under different deposition time. Besides, Titanium(IV) isopropoxide ($Ti\{OCH(CH_3)_2\}_4$) was used as a precursor to fabricate a hydrophobic film on the substrate. The hydrophobicity of deposited coatings is improved by derivatization of coatings with Hexadecyltrimethoxysilane (HDTMS) as a silylating agent in ethanol for 24 h. The coated surfaces were characterized by static water contact angle (CA), water tilting angle (TA), Ultraviolet-Visible spectroscopy (UV-Vis) and Scanning Electron microscopy (SEM). The enhancement of wetting behaviour is obtained by the sandpapered substrate that is accounted for maximum static water contact angle of 112.49° under 15 min deposition time in 5 mol L^{-1} NaOH and 24 hrs deposition time in HDTMS. It is also evident that the minimum dynamic water tilting angle is around 10.9 for the substrate dipped in 1 mol L^{-1} NaOH for 1hr and HDTMS for 24 hrs. Results indicate that the most of the coated surfaces attained optical transmittance above 75% in the visible region (378 nm) of the resulted spectrum. It is also evident that the transparent superhydrophobic coatings can be achieve excellent behavior properties with good optical transmission by controlling the surface roughness of the resultant coatings.

Keywords: Transparent, Superhydrophobic, Hexadecyltrimethoxysilane, Etching, Roughness

Synthesis and Characterization of Nano Zeolite-A (LTA Zeolites) With Aid of Sodium Dodecyl Sulfate (SDS) as Particle Size-Controlling Agent

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The conventional synthetic zeolites historically known as molecular sieves are crystalline aluminosilicates with well-defined pores. Nano zeolite-A synthesis has received considerable attention in the past decade and has today turned into essential in commercial materials. Usually, LTA zeolites (Linde Type A) are synthesized via low-temperature hydrothermal crystallization in the presence of the structure directing agents, known as "organic templates". Generally, Tetramethylammonium-hydroxide will be used as a template. However, these templates are expensive and non-recyclable. Therefore, under the green chemistry point of view, numerous efforts have been devoted to synthesize template free LTA type nano zeolites. In this work, nano Zeolite-A was synthesized via both hydrothermal and microwave methods in the absence of organic templates. Instead of them, an anionic surfactant called Sodium dodecyl sulfate (SDS) was used for controlling the particle size. The effect of different crystallization conditions such as aging time, reaction time and temperature for changing properties such as particle size, morphology were investigated. The final products were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray (EDX) and Fourier-transform infrared spectroscopy (FTIR) techniques. The obtained SEM and XDR results showed that both methods have produced pure LTA zeolites crystals with a 300 - 500 nm range in size with a high degree of crystallinity. In addition, the absence of characteristic zeolitic water peaks proved the synthesized compound was in dehydrated form. Compared to the hydrothermal method microwave approach is effective because it requires less reaction time and no any considerable change observed in crystal size and crystallinity. Therefore, surfactant based zeolite-A synthesis would be potentially important in the chemical industry due to its competitive advantages as a green approach and cost-effectiveness.

Keywords: Nano zeolite-A, Organic templates, Surfactants, Microwave method, Hydrothermal crystallization

Mechanical Engineering & Mechatronics

- Mechanical Engineering
- Mechatronics
- Electrical and Electronic Engineering
- CAD/CAM/CAE
- Control Engineering
- Robotics
- Automation

A Proposed Design to Peel-off the Brown Skin of Coconut

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Coconut industry has stepped in to new ventures apart from just selling the coconut fruit to the local and international market. Even though every part of the coconut tree is being used, this research is mainly focused on food and beverage production from the coconut fruit. The outer shell of the coconut fruit needed to be removed and then the brown skin also needed to be removed before processing the fruit to produce value added products such as, coconut milk, desiccated coconut, pure coconut oil, virgin oil, toasted coconut chips (with and without flavour), refreshments made from coconut water. Generally, coconuts are de-watered (remove the inside water) by drilling the shell and the hard outer shell is removed by a de-shelling machine which then the brown skin is removed before processing further. This study concentrates on the removing of coconut brown skin which called peeling. There are several methods for peeling and the most popular one is the manually peeling using a knife which is called as paring knife method. It was evident that by peeling knife method, production rate cannot be increased without increasing the labour which the skilled labour is extremely difficult to find and takes considerable amount for training. Even with skilled labour it was found that a considerable amount of waste of the coconut fruit occurs. This study proposes and develops a novel method to eliminate the mentioned drawbacks of peeling by steaming and then washing using high pressurized water jet. The design was optimized by conducting arranged experiments along with trial and error method. The final product of the coconut fruit satisfies all the requirements needed to be processed. The productivity is improved by 47% and the reduction of wastage is 57%. Along with that it minimize labour force, to improve productivity and to find a solution for ulcerating of hands due to oily condition were achieved by introducing the proposed machine.

Keywords: Coconut based food & beverage, Peeling off brown skin

A Power Conversion Method Based on Decentralized PID Controllers to Overcome the Power Deficiencies of a RF Thermal Emission Tube

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Thermal emission tubes are expensive electron devices regularly used in numerous applications such as Radio Frequency (RF) amplifiers, medical instruments, etc. In this work, an efficient RF power conversion method of a thermal emission tube which is employed as an RF amplifier within a 250kW shortwave transmitter in the Sri Lanka Broadcasting Corporation (SLBC), Trincomalee is discussed. The tube works as a class C amplifier within the frequency range of 6MHz-21MHz. It occasionally malfunctions due to its poor control capabilities. More often, the tube does not operate at its optimal or highest efficient point. As a consequence, a large amount of input electrical power is dissipated as heat within the tube itself. It is harmful for the internal structure of the tube. In this work, it is proposed to replace the existing fine-tuning controller with a closed loop control system. The proposed control scheme based on decentralized multiple PID controllers and H-infinity optimality criterion was tested for fine-tuning of the amplifier's final RF stage. The PID control gains were found using an algorithm based on Linear Matrix Inequality ensuring the stability of the closed loop system. The proposed controller should tune two fine-tuning elements, inductor, and capacitor until the phase difference between input and output RF of the emission tube (PHI2) becomes close to 180 degrees, and RF power (PWR) to the antenna or load reaches the expected value set by the operator. Test Results are obtained for several operating frequencies which drive the RF amplifier with half RF power, 125kW. Hence, the reference set point for controlled variable PWR is set to 3.125V. The reference value for controlled variable PHI2 is set to 5V. The behavior of the output variables, PHI2, and, PWR are compared for both existing and proposed controllers. The results validated the desired control capabilities of the proposed controller.

Keywords: PID controller, Power converter, RF, Thermal emission tubes

Obstacle Avoidance of Mobile Robots Using External Camera Information

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The increasing popularity and affordability of mobile robots result in the development of technologies and have improved them to perform in a better, efficient manner. Mobile robots are helpful in solving much complex tasks that humans are not even aware to provide solutions, while technology has developed in such a manner where this generation of robots have new capabilities without having new hardware. As an example, when it comes to the navigation of autonomous mobile robots, they require multiple sets of sensors such as sonar, laser or visual based sensors in order to navigate autonomously avoiding obstacles, which leads complex calculations locally. Having a collection of such robots will complicate the navigation and require high costs. That kind of on-board sensor setups cannot avoid blind-spots as they have a very limited range and positioned only to see specific directions. This research proposes a cloud-based platform with a network of external camera infrastructure for efficient, up-to-date path planning. The autonomous robots can request platform aid for navigation and platform will send the best possible navigation route according to the priority and the location of the robot in each situation. This enables the robots to take decisions in real time avoiding live obstacles and navigate from point A to point B with minimum delay. This will reduce the extra clutter, the amount of local data that is needed to be sent to the centralized platform for navigation and will simplify robot further development and implementation. The simulation results and implementation show the successfulness of the proposed method. This newly opened pathways will not limit the capabilities as everything is dependent on the platform itself and critical changes such as improving efficiency can be done in a robust manner instead of each and individual mobile robot.

Keywords: Mobile robot navigation, Path planning, Obstacle avoidance, External camera network, Robot communication platform

Autonomous Battery Replacement System for Surveillance Drones

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Surveillance and monitoring are being widely used in areas such as home automation, road surveillance, monitoring cattle, identifying wildfire and ubiquitous sensing. Even though there are various other surveillance methods currently available in the market, computer-controlled unmanned aerial vehicles (UAV) found to be one of the successful ways since the motion of it is unrestricted within a surveillance boundary without being bind by ground interference. One of the disadvantages of UAV is the duration of flight since a typical UAV can only fly about 10 minutes using Li-Po batteries, which is a major drawback for tasks like aerial surveillance which requires longer flying duration. So that this research is based on autonomous battery replacement along with charging of the battery. In this process, the surveillance drone is assumed to be landed by image processing technique within 20cm radius of the exact location. After the landing, it is positioned autonomously. Then a gripper grabs the discharged battery from the drone and places it into the empty charging bay. Thereafter, the rotary manipulator grabs the charged battery pack and replaces the drone battery slot by the charged battery. Finally, the drone takes off with the fully charged battery. Initial experiments are conducted using the developed system and successfully estimated the outcome of continuous surveillance. The base station is used to landing, removing & replacing the battery and charging. It is a mechatronic system, which was designed and implemented successfully. According to the results, the objectives of the project such as centering the drone to the secondary dock and battery replacing are achieved successfully. Therefore, the system could be suggested for surveillance and package delivery drones which come across the problem of insufficient battery life.

Keywords: Unmanned aerial vehicles, Battery replacement, Surveillance drones, Drone battery

Invention of Table Top Steam Sterilizer

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The sterilization is a process of making something free from harmful bacteria or other living microorganisms which is very important in healthcare industry. This research project was mainly focused on inventing cost effective, automated and efficient horizontal type table top steam sterilizer. The entire research project was launched in a very innovative way. As the initial step, physical structure was designed prioritizing on low cost materials and obeying the international standards. After that, electronic circuit was designed for both direct current (DC) power & alternative AC power to drive software and operate the hardware utilities respectively. The software system was created in Arduino platform. The system consists of two program cycles which are at 121 ^{0}C temperature 20 minutes and 134 ^{0}C temperature in 15 minutes. The real time temperature and pressure data were displayed in liquid crystal display (LCD) and manual pressure gauge respectively. Various safety precaution methods were included to the machine for both safety of operator and instrument. The unique features of this research project are availability of ultraviolet (UV) sterilization method in addition to steam sterilization method & message alert system that sends real time operation data such as door status, water level status, program cycle termination data and UV sterilization status provided for the operator's mobile phone. The UV sterilization automatically turns ON when loading and unloading packages from the sterilizer. To check the performances of this machine, few sterilizing cycles were run and it was confirmed that expected outcomes have been fulfilled by this machine. It used to prevent environmental contamination during the period of unloading packages. This program cycles are fully automated and operator only has to push a single button. It will be a very user friendly, cost effective and versatile table top steam sterilizer for healthcare industry.

Keywords: Diagnostic, Synchronized, Utilities, Versatile

Analysis of a Brick Made by Polythene and Silica Using Finite Element Analysis

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Polythene waste is an eyesore prevailing in today's society which leads to the contamination of environment and air when discarding or burning. A method of obtaining high strength bricks by aggregating polyethylene (PE) with sand (silica) at various percentages can be introduced as a method of effective utilization of waste polythene. In this research Finite Element Analysis (FEA) is used in order to analyse the brick according to its complex material structure. Finite element method is a numerical computerized technique used for predicting the reactions of objects to real-world forces, vibration, heat, fluid flow, and other physical effects. FEA reduces number of physical prototypes and experiments and optimize components in design phase in order to develop better products efficiently and effectively. Time, money and effort for wrong experimental methods can be saved by using FEA. In this research Femap software is used for the overall analysis. Composite formed by polythene and silica is mapped in the software platform. Number of models were analysed by changing the applied temperature level and force level. Post processing data of the analysis were used in order to determine the optimum result. According to the analysis results a temperature between 120^0C to 180^0C should be supplied to the brick while it is compressed by 20N to 60N force.

Keywords: Polythene silica brick, Finite Element Analysis (FEA), Femap

Construction of Locomotion Models of a Snake Robot

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Biological snakes use different modes of locomotion on terrain and underwater to fulfill their needs. These locomotion models help them to adapt to different environments where they live. Snake robots which has the locomotion models same as biological snakes will possess similar capabilities enabling them to be used in applications involving complicated environments fulfilling modern human needs such as urban search and rescue, maintenance in narrow places or dangerous surroundings to human and military needs such as spying. Snake robots can traverse inaccessible environments more efficiently than the motor driven conventional wheeled vehicles. Construction of this robot is fulfilled by using ten linkages, ten servo motors, microcontroller and 7.5V battery. The rectilinear and serpentine motions of the robot are controlled by the Arduino microcontroller. In this work, considering the kinematic and dynamics of biological snakes, the design of a segment of robot was designed by using the computer aided designing software and those segments were 3D printed using ABS fiber material. Kinematics and dynamics of locomotion methods of snakes simplified and coded by using C+ language to the microcontroller of snake robot. Constructing a low-cost, passive caster wheeled snake robot which has locomotion models of biological snakes was developed.

Keywords: Snake robot, Locomotion models, Caster wheeled, Low-cost

Smart Power Saving Climate Control System for Tea Nurseries in Sri Lanka

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Tea industry is the one of main foreign exchange source in Sri Lankan economy presently faces many challenges such as newly developed competitors, poor yielding tea varieties, poor resistive cultivars for newly developed bio-attacks possibly due to climatic changes and other phenomena. Tea varieties from different regions of country have different qualities and bio-resistance issues. This project is to mitigate above problems by introducing an affordable climatic chamber for Tea nurseries, to generate artificial climatic condition. Climatic chamber is automated with a system that has the ability to control weather conditions constantly, despite of the fluctuations in external natural weather conditions. The system includes a smart power saving weather control system controlled by Atmel microcontrollers, for greenhouses in tea nurseries. Climate control is achieved by several actuators which are interfaced to the microcontrollers via high voltage contactors connected to relay board. Priority is given to low power consuming actuators to act first for the sensor readings by the programmed logic. If it fails to maintain desired climatic conditions, signals are given to activate power consuming, efficient actuators automatically by the program logic. The microcontrollers, sensors and actuators together maintain the temperature, relative humidity, light intensity, CO_2 concentration and soil moisture of greenhouse to the reference ideal value which is a source of input interfaced into the microcontrollers through LCD screen and keypad. A priority order is programmed through logic preventing the impact of change in one factor affecting the other factor. All factors except humidity were controlled successfully, while system consumed more time to maintain humidity as it has high impact over temperature. A reference range of climatic factors instead of a single ideal climatic value as in our system will be more favorable and recommended for power saving.

Keywords: Atmel microcontrollers, Relay board, Tea industry, Climate control, Lcd screen

Autonomous Lawn Mower

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Modern houses include a compound often used as garden with grass which grows and need to be maintained at a short height. Conventional lawn mowing is often a hassle and time consuming in cutting the grass. The task of manual lawn mowing can be replaced by autonomous lawn mower using a robot programmed to perform such task. A robotic lawn mower is designed and installed in this research, So the main research problem is creating an Automatic lawn mower that will allow house owners to maintain their lawn without spending much time and money, with the specialties of autonomous robot can mow the lawn of a given specific area of the garden without any human supervision, easy and simple preparation and the robot must be affordable cost for local market. For the implement part of the research following materials and soft wares used RF receiver and transmitter, Lipo- Polymer battery, Grass cutting blade and motor, Arduino Mega 2560 development board used DC gear motors with encoders and MPU6050 gyroscope was used for localization part and for the programming IDE Arduino 1.8.2 was used.

Keywords: Autonomous lawn mower, Encoders, Localization, MPU 6050

Self-Navigated Vehicle for Industrial Applications

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This study presents the innovation of the industrial autonomous navigation system. AVG installation consist of several building components; the vehicle, safety system, battery charging system, communication system, navigation system, traffic management system, job control system and other external components. Each of these systems has provided a specific function. Specially navigation system has provided the ability for the vehicle to identify its position. AGVs have to make decisions on path selection. The sensors installed on its on-board computer possessed all the data to calculate the position and orientation of the AGV. Sensors also capable of detecting magnetic markers made of tape of opposite polarity. Every AGV has a mapping system and a copy of the route map stored in its on-board computer. The route map contains routes, obstacles and pick up and drop up points. The encoders mounted on each wheel of AGV able to measure the steering angle and count the number of wheel revolution. Usually magnetic tape used as a path selection technique in AGVs. Here the position is identified using IMU (Inertial measurement unit) module. In here Euler angels were used to find the direction. Conventionally IMU module produces enormous noise and not enough accurate to use in specific applications. But in this study, the noise of IMU module is decreased and the accuracy is increased by the Kalman filter and the algorithm was built by us. The main purpose of this research is to make a more reliable automated industrial vehicle which can use and install easily. The sticking problems and maintaining difficulties are avoided. This modified AGVs have a high degree of flexibility to transfer material to the destined position. They only recharge when there is a gap in their auto planning and their recharge is a dynamic process. AGV provide an accurate and predictable material delivery, handling loads at different heights, complete routines, flexibility, clear aisles and organized workstations (Grid navigation) and its safe for people and loads.

Keywords: Autonomous navigation, SLAM, AGV, IMU

Electronic Bus Ticket System

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In Sri Lanka transportation is mainly based on road network. Buses are the principal mode of public transport. Bus service is provided by the Sri Lanka Transport Board (SLTB) and privately owned buses. Main objective of the project is to make passengers journey comfortable, facilitate conductor and drivers work easy and eliminate the cheating done by passenger by automating the ticket system. It also helps driver to easily identify the bus stops where he needs to drop the passenger and how many passengers. Therefore, he can drive smoothly. System contains conductor display unit and driver display unit. Both units connected by the Bluetooth module (HC-05). In conductor module, conductor prints a ticket to a passenger by keypad and send the bus stop detail to the Arduino, then the Arduino transfer signal to Bluetooth module. Finally, Bluetooth module receive the command and it send to the next Bluetooth module of the driver unit. Then driver unit receive the signal and it display how many passengers to drop on each stop, on its display. Then cheating also will be reduced. Driver know in advance where to stop the bus. Passengers no need to ring the bell to inform the driver to stop the bus. Therefore, the journey will be smooth and comfortable for both the passenger and driver. If the system is embedded with google map, then it will be more convenient for driver. As a future implementation to make the system more efficient incorporate google map to display the bus stop.

Keywords: Electronic bus ticket system, Bluetooth module, Autonomous, Arduino

Development of an Automated Beep Test Machine to Count the Levels, Shuttles and VO_2 Max Level

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The beep test is considered as a standardized method of measuring the maximum volume of oxygen (VO_2 max) capacity and analyzing the fitness requirements for sport. This test involves running towards and back between two lines 20 meters apart, evaluated with a pre-recorded audio which plays beep sound within a scheduled time period. During several levels, the athlete progresses up and each new level is reached when beep sound is getting faster. The point where athlete cannot reach before beep sound is considered as the level that athlete fails to complete, likewise for each athlete is given three chances to complete that level. However, even after those three chances, if they fail to reach the line before beep sound that becomes their highest score and the bleep test is finished. Currently, the beep test is conducted manually by the assistance of experienced coaches, therefore the development of automated beep test machine was carried out under this study to avoid the errors that could be made by the beep test conductor, when measuring and recording the shuttles, levels, and VO_2 max level. This machine is operated under four units namely shuttle identification unit, faults identification unit, controlling and processing unit and data analyzing unit. The detected data such as shuttles, levels, and VO_2 max level can be analyzed and transferred automatically into the database by using two shuttle identification units and one fault identification unit. A buzzer and seven segment display were connected to the controlling and processing unit to produce the beep sound and display the state of the fault of the athletes respectively. On the performances checking, the machine was able to generate a sound by the buzzer at each fault and display the status on the seven segment display. At the end of the process, the system generated the VO_2 max of the athlete according to the body weight of the athlete. When inventing this machine, the priority was given to high durability and low cost.

Keywords: Beep test, Shuttle, Athlete, Machine

A Digital Device to Measure Distance on Multiple Surfaces

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Measurements are one of the daily procedures to separate the needed length in apparel industries. Measuring tape is the only available method for this process now a days. Even shoulder measurements in tailor shop is taken by measuring tape too. This might consumes time and causes error while taking measurements quickly. So there is a need for the independent measuring system to solve this deficiency. A pen like structure of diameter 3.5cm cylindrical wooden bar was cut and further diameter of 2cm was drilled in that where the components were set. A Keyes KY-040, rotary encoder was used to count the rotation was attached to the end of the cylinder. Smooth surface and rough surface shaped disc were made using 3D printers and those models were designed using SolidWorks software. These discs can be attached to the encoder shaft according to the surface where the device is used. Arduino Nano was used as microcontroller for performing algorithmic work. Liquid crystal display was used to display the output measurement. This measurement can be displayed in Centimeter, Foot and Inch scales at the press of a button. Error corrections were done according to the measurements obtained from the Measuring device. 96% percentage accuracy was obtained on the random measurements

Keywords: Measuring pen, Easy measurement, Scale, Measuring tape

Web Server Based Mobile Weather Analyzer System

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Weather, which means the condition of the atmosphere at a particular time and a place is a fascinating topic since nineteenth century, as the monitoring of weather is helpful for various human activities. Barometer, Anemometer, Thermometer are separately used and data is analyzed in order to predict weather. Nowadays, lot of high-end weather analyzing systems are available in the world which are designed and developed in a large scale, for monitoring the weather in a city or a state. Enormous size of the available system, higher maintenance costs are some of the difficulties face with in the current large scale system. The designed system is designed for the individuals like farmers with large scale farms. The system is designed as a mobile unit which works with battery power as well as solar energy. System is portable and can be fixed at any suitable place as the data transmission is done through General Packet Radio Services. User is able to link the device with the official web site, which provides necessary details and the data can be accessed by logging in to user's account. Temperature, atmospheric pressure, humidity, wind speed, wind direction, altitude and precipitation are measured and the data is automatically updated once per hour. User is able to take a clear image about the weather condition of the installed place for the next few hours and the tasks can be scheduled. The device should be placed at clear outdoor place for more accurate readings. The anemometer can measure real time wind speed with 85 - 95% accuracy. In addition, systems for getting weather details at local places such as homes, farms, are not available and the collected data aren't stored in cloud. Therefore, this system can be used in order to collect a bulk of data which is important for advance forecasting algorithms.

Keywords: Weather, Arduino, Weather analyzer, Weather forecast

Autonomous Human Following Shopping Trolley Integrated with Smart Shopping Android Application for Sri Lankan Supermarkets

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Robotics applications have made tremendous advancements in the previous decade and it has evolved to perform certain day-to-day tasks, despite it was generally used for industrial tasks. In developed countries, autonomous robot assistants who interact with people are currently employed in grocery industry scenarios with the intention of aiding consumers to make the shopping process more efficient. This research paper attempts to propose a smart shopping system that can be implemented in Sri Lankan supermarkets. The proposed system consists of three major components. a) a mobile device that is carried by the consumer b) a human following shopping trolley c) an Android application with auto billing generation capability. Previous researches have been carried out to implement a human tracking robot utilizing high end, costly technologies such as Laser Range Finders, Kinect cameras and low-end sensors such as ultrasonic sensors. The proposed human tracking unit utilizes Wi-Fi technology to reduce the cost for sensory devices and follow the trajectory of a consumer with higher accuracy. The trolley navigates inside the supermarket following a target consumer while maintaining a safe distance using ultrasonic sensors. The relative position and orientation of the target consumer are determined by utilizing Received Signal Strength Indicator values of Wi-Fi signals. Ultrasonic sensors are deployed to follow the customer while maintaining a safe distance and avoid collisions with obstacles in the supermarket. The designed Android application enables the consumer to scan the bar code printed on goods, prepare a list consisting of items that he wishes to purchase and calculate the total values of items purchased. This approach drastically reduces the time spent at the billing counter. The mobile platforms were developed using Arduino and Node MCU micro controllers and the Android application was developed using MIT app inventor.

Keywords: Human following shopping cart, Android application, Wi-Fi technology, RSSI values

Application of Graph Theory for a Pick and Place Machine

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Automation is the use of control system for handling different process and machineries in an industry to replace human. Pick and place machine are one of the important machines used in Robotic industry. In here Printed Circuit Boards (PCB) are consumed as input. Graph Theory can be used to find the shortest path in PCB to place the components in PCB. PCBs are ubiquitous. So, most electronic manufacturing industries relays on PCB as they serve as backbone of almost every electronic device. Therefore, PCB plays a vital role in many industrial production processes. Some machines don't choose the optimal route to complete their task. So, this research is mainly based on finding the shortest path way in PCB by using appropriate algorithm. Starting from a random point, the nearest point to the initial position was determined and automatically updated by the selected algorithm. This process was continued until analyzing all points and obtaining a feasible solution in the determination of optimal route. In here three types of algorithm were selected for my studies to find and confirm the shortest path. They are Dijkstra's algorithm, Genetic algorithm and Floyd's algorithm. Among these Floyd's algorithm works slower than other algorithms and Genetic algorithm displays shortest path in a matrix form for a selected PCB design. Dijkstra's algorithm guarantees to find the shortest path much faster and in easily visible form. The analysis shows that the best route which provide the part of the shortest distance will be from node 36-47-7-34-25-37-32 with 1.34 m. This concluded that the Dijkstra's algorithm is the best method to find optimal route for PCB in pick and place machine. So, this method is much effective and leads to find the shortest path in Printed Circuit Boards.

Keywords: Printed circuit boards, Pick and place machine, Dijkstra's algorithm, Genetic algorithm, Floyd's algorithm

Design a Modular Mechatronic Systems: Design a Packaging Machine

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Concept of modularity is practicing in many fields over decades, such as software engineering, computer science, civil engineering, and electrical engineering. It has been proven that modular architecture has much more advantage than traditional integrated architecture in certain fields. This paper proposes modular design architecture for a mechatronics system in more practical manner. Here we mainly focused on the increasing simplicity of the system, ability to upgrade according to rapidly changing market needs, and reduce the cost in manufacturing and maintaining using modular architecture. The proposed process is a combination of traditional methods such as top down approach, Bottom up approach, sequential approach and mechatronic design quotient. To demonstrate the method, it is applied to design a vertical dispenser packaging machine called the "VD packaging machine" – a multidisciplinary machine use to pack cubic products in a vertical display. There are several types of packaging machines available in modern world, but none of them are useful in this VD-package filling process. So in this paper we are going to examine the VD-package filling process and give a step vise guide about how to design a modular mechatronics system to automate the process. The use of modular concepts in mechatronics system allows simple as well as efficient and therefore low-cost sustainable product, easy to maintain and changeover.

Keywords: Modularity, Design, Automate, Low cost

Designing a Fully Automated Pot for Gardeners and a Survey on the Use of the Features to the Consumers

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This research introduces a new design for an automatic plant caring system which can be used for planting herbs, vegetables or ornamental plants as per consumers' choice. At present, people are accustomed to purchasing vegetables and fruits from the market, and it seems that only a few people supply their food from their own garden. Many researches have been carried out parallel to this subject on separate features such as automatic watering, automatic fertilizing, and pest and weed controlling and automatic lighting system. A survey on the difficulties faced by horticulturists and the importance of automatic plant caring systems was done by selecting people chosen at random. The age of the selected group ranged between 10-80 years. Result of the survey was analyzed. Moreover the features included in this design and the priority given by the gardener for the highest price that wishes to purchase such items was evaluated in the survey. Majority of the people have requested the item for a price less than 1000 rupees. By evaluating the survey, most of them concluded that there was no time for gardening to be a major problem. Problems other than that were pests, weeds and climate issues. Most people request automatic water supply, pest and weed control and automatic fertilizer as the features included in the automatic plant caring system. In this research, appropriate design of automatic plant care system was also introduced using software. This system is designed to use drip hydroponic technique where fertilizer is supplied via water by dripping plant roots into a tank. When there is no sunlight, light is automatically supplied using the LED panel. The purpose of this work is to show how someone can easily engage in gardening and use this device to supply fresh vegetables and fruits. Similarly, this pot can also be used as a decorative item by planting ornamental plants.

Keywords: Plant, Automatic, Survey, Gardeners, Maximum

Design and Development of EMG Controlled Prosthetics Lower Limb

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Amputees faces many difficulties to perform daily routine activities in their life. A limb with responding character based on sensor reading is not available in market for low prices. The purpose of the research is to develop an EMG controlled prosthetics limb with one degree of freedom at low cost. The prototype prosthetic leg was modeled using Solidworks software and then parts were printed using a 3D printer. Then, the assembled Prosthetics Lower Limb was controlled by an Arduino board interfaced with Electromyography sensors and stepper motors. Electromyography is a special method for evaluating and recording the electrical activity produced by skeletal muscles. It detects electric potential generated through human brain by movement of the muscle cells. Electromyography output signal was fed to the Arduino microcontroller which was programmed to acquire the angle and transformation of the natural limb based on its readings. Produced output signal was fed to the stepper motor through stepper motor driver. Then the prosthetic limb was actuated by linear stepper drives based on sensor reading, mimicking human limb. There, the Kalman filter was used to filter the EMG signal to minimize the noise. The modelled limb mimicked human limb with one degree of freedom. Efficiency of the system is low, as the quantity of sensors used is three instead of four which could produce more efficient signals. An average of threshold value for EMG signals should be found as it varies for each individuals. Modelling the system with at least three degree of freedom using four electromyography sensors is recommended as the future aspect for this project.

Keywords: Electromyography (EMG), Prosthetics leg, 3D modelling, Arduino, Kalman filter.

Efficient Autonomous Guided Vehicle for Transporting Material in Sri Lankan Industry

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Autonomous Guided Vehicles (AGV) are used frequently in production lines for transporting various materials. Most of the times these AGVs are been controlled by Programmable Logic Controllers (PLCs), RobotQ, RaspberryPi and Arduino platforms. In SriLanka, most of the times apparel industry used the small size of AGVs to transport various materials. The intention of the research is to develop an AGV which is rich with path following, low turning radius, self-battery charging, PID controlling in a rough environment for Sri Lankan industry rather than specifying the apparel industry. A PLC has used here to control the overall process of the AGV. There is a special hooking mechanism and push-pull mechanism which are controlled by Programmable Logic Controller (PLC). AGV follows the paths of magnetic tapes which are located on the floor. Starting and stopping positions will be detected by the AGV and the loading and unloading will occur. Loading and unloading mechanism will be done by using a linear actuator. There is a special linear actuator which can be used as a special jack in the AGV. Overall AGV system is run by using a drive unit which consists of two brushless direct current motors (BLDC). An 8-bit magnetic sensor array is used to detect the path of the AGV. Future developments will be added to this AGV with digital image processing and artificial intelligence (AI).

Keywords: AGV, PID, BLDC, AI

Sustainable Animal Production Technology

- Animal Nutrition and Feed Production
- Animal Health Welfare and Farm Bio-security
- Organic and Alternative Livestock Production
- Rural Development, Organization and Economic of Livestock Production
- Animal Production and Impact on Environmental Sustainability
- Current Issues in Animal Production

Effect of Black Cumin Seed Meal (*Nigella Sativa*) on Performance, Meat Quality and Intestinal Microflora of Broilers

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The aim of this study was to evaluate the effects of black cumin seed meal (*Nigella sativa*) included diet on the performance, carcass characteristics and intestinal microbial population of broiler chicken. A total of 180 one-day-old broiler chicks (Cobb 500) were allocated to four dietary treatment groups with five replicates each of 9 chicks and reared for 42 days. Experimental diets were prepared by replacing maize with black cumin seed meal (BCSM) at the rate of 0% (control, C), 10% (T1), 15% (T2), and 20% (T3). The statistically analyzed data revealed that T1 diet increased (P<0.05) the body weight gain of broilers compared to T2, and T3 at day 42. Dietary BCSM did not have a significant effect on the dressing percentage of birds. Birds fed with 10% maize replacement with BCSM recorded the lowest (P <0.05) malondialdehyde (MDA) content (3.38 µmol/kg) for Thiobarbituriacid Reactive Substances assay in chicken meat at 7th day of storage and the highest (P <0.05) ceacal lactic acid bacteria population (1.56 log CFU/mL) than other treatments. Further, the present study indicated that 10% replacement of maize with BCSM in the broiler diet has beneficial effects on body weight gain, MDA value and caecal lactic acid bacteria population. Also, it showed a decreased tendency in coliform bacteria population in the caecal content. Moreover, it has significantly affected meat quality attributes where the highest (P <0.05) score (5.93) for taste resulted. In conclusion, replacing maize with up to 10% BSCM in the diets of broilers has positive effects on body weight gain, carcass characteristics and caecal microbial population.

Keywords: Black cumin seed meal, Broiler chicken, Performance, Meat quality, Microflora

Effect of Storage Time on the Physical Changes and Proximate Composition of Feed Ingredients Stored Under Room Temperature

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Quality of the feed ingredient is one of the most important factor considered by feed processing industries. Feed ingredients are comprised with many nutrients and the nutrient availability varies due to different reasons. This study was conducted to evaluate the effect of storage time on the physical changes and proximate composition of feed ingredients stored under room temperature. Newly arrived maize, rice polish and coconut poonac samples were collected, packed using woven polypropylene bags and stored for two months under room temperature. Physical changes and proximate composition of samples were checked at 15-day time intervals and data were analyzed by Kruskal–Wallis test and one-way analysis variance using Minitab 17 software respectively. There were physical changes in rice polish and coconut poonac ($p<0.05$) while there were no physical changes observed in maize during storage period ($p>0.05$) and rice polish was infestation by insects after 45 days of storage. During storage period crude fat, crude protein, ash and fiber contents of rice polish were decreased by 65.25%, 20.89%, 4.69% and 7.35% respectively ($p<0.05$). Crude fat, crude protein, ash and fiber content of coconut poonac were decreased by 19.71%, 23.05%, 7.62% and 8.46% respectively($p<0.05$). Except moisture, other macro nutrients of maize did not change with the storage time ($p>0.05$). Therefore, it can be concluded; that proximate composition of coconut poonac and rice polish were decreased considerably during the storage under room temperature. Further, changes of physical characteristics of feed ingredients are not sufficient to determine the quality of stored feed ingredients.

Keywords: Feed ingredients, Physical changes, Proximate composition, Room temperature, Storage time

Effect of Soy Bean Meal and CO-4 Grasses on Milk Production of Milking Cows in Mid Lactation Period

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Dairy industry in Sri Lanka is the main sub sector of livestock development at present. Milk yield per cow and the cost of feed to produce milk have greatest influence for profitability of a dairy operation. This study was conducted to determine the effect of soy bean meal (SBM) and CO-4 grasses on milk production of milking cows (3-5 years old) in mid lactation period. A total of twelve dairy cows were randomly assigned into three dietary treatments. Each treatment comprised two blocks according to stage of lactation and two cows were included in each block. Mid lactation stage milking cows were selected to three dietary treatments and each treatment comprised with 4 replicates. The control group (T_0) of milking cows was fed concentrate (existing) feed and CO-3 grasses. The cows in T_1 treatment were treated with concentrate feed enriched with SBM and CO-3 grasses and cows in T_2 treatment were fed concentrate feed enriched with SBM and CO-4 grasses. Morning and evening milk yields were measured and milk quality (fat and SNF) was checked weekly. All the collected data were analyzed using repeated measures ANOVA and t-paired test. There were no significant differences in average milk yield of cows between T_0 and T_1, however the average milk yield of cows in T_2 has increased significantly ($p<0.05$). The highest fat value (4.7%) and SNF value (9.37) were recorded from the milk collected from cows in T_2. In conclusion, the dietary supplementation of SBM and CO-4 grasses included diet had better effects on milk yield and quality of the milk.

Keywords: Soy bean meal, CO-4, Milk yield, Milk quality

Antimicrobial Effect of Immunoglobulin Y (IgY) Extracted from Village Chicken Eggs and Farm Chicken Eggs Against *Salmonella*

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Chicken Immunoglobulin Y (IgY) found in egg yolk acts as the main innate immune response against the systemic infections in early stages of chick life. Colibacillosis and salmonellosis are important bacterial diseases which can lead to early chick death. However, the survival rate of indigenous day-old chicks against such diseases is believed to be higher compared to the farm day-old chicks which may have contributed from the IgY activity present in egg yolk. The current study was focused to compare the IgY content in village and farm chicken eggs and to compare the antimicrobial effects of IgY found in both egg types against *Salmonella*. Six village and six farm laying hens were identified for the egg collection. Gallus Immunotech Chicken IgY Egg Press Purification Kit was used to extract the IgY. Fourier-transform infrared (FTIR) spectroscopy and 10% SDS-PAGE gel electrophoresis under reducing and non-reducing conditions were used to confirm the extracted IgY. Extracted protein concentration (mg mL^{-1}) of samples was measured using nanodrop spectroscopy. The Mann-Whitey test was used to compare the yield analysis (mg). Antimicrobial susceptibility of extracted IgY was determined against *Salmonella* sp. isolated from dead day-old chicks. Inhibition reactions of IgY was measured using agar well diffusion assay by turbidity of broth adjusted to the 0.5 McFarland standard. Extracted protein concentration was (7.35±0.92) and (7.12±0.93) in village and farm samples, respectively. Although there was no significant difference, village chicken eggs showed higher IgY yield (132.47±22.31) compared to farm chicken eggs (115.01±17.40). There was no significant different in inhibition zones (mm) of IgY extracted from village (12.1±2.3) and farm (11.3±1.9) chicken eggs. In conclusion, IgY extracted from both village and farm chicken eggs had a similar antimicrobial effect against *Salmonella*. However, increasing the sample size can improve the accuracy of this preliminary study.

Keywords: Immunoglobulin Y, Village eggs, Farm eggs, *Salmonella* sp., Antimicrobial

A Preliminary Study on Current Status of Dairy Cattle Farming in Mannar District

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Dairy cattle farming in Sri Lanka has a direct impact on income generation, poverty alleviation and provision of animal proteins to households. Hence, it plays a vital role in areas such as Northern Province, which is recovering from a conflict period. Therefore, the objective of the current survey was to study the present status of dairy cattle farming in Mannar district of Northern Province. The study was designed to assess the dairy farming practices and its constraints. A pre-tested questionnaire was used to collect data from 254 dairy farmers whom were selected using stratified and simple random sampling from 5 veterinary regions of Mannar district. The highest number of farms had local cattle breeds (89.37%). Sahiwal crosses (9.05%) and Jersey crosses (0.78%) were observed in less number of farms. Most of the farms (92.9%) used stud bulls for cattle breeding. Average herd size of cattle farms was 34 animals. Yet, average proportion of milking cows from herd was 35.34%. Major source of forages were from wild and roadsides (71%). Concentrate and mineral supplementation were given to animals only by 12% and 10% of farmers respectively. Extensive management system (66.9%) was observed as the major dairy cattle rearing system in the area. Hence, cattle sheds were not available for 62% of the farms. Average milk production of the area was 1.59 ± 0.442 L/cow/day. Significantly higher ($P<0.05$) milk production was observed in Manthai West (2.1 L/Cow/day) and the lowest was observed in Musali (1.3 L/cow/day). Even though most of the farmers (72%) had more than 5 years of experience in cattle farming, their knowledge level on dairy farming was observed to be poor. Major constraints identified were; lack of improved cattle breeds, poor knowledge level on dairy farming, lack of improved forages and poor extension facilities. In conclusion, to alleviate the poor status of dairy farming in Mannar District, strategies should be aimed to address aforementioned constraints.

Keywords: Dairy cattle, Milk production, Local breeds, Sahiwal

Evaluation of Growth Performance and Nutritional Composition of Three Fodder Crops (Maize, Sugargraze and Nutrifeed) Cultivated in Omanthai, Northern Region of Sri Lanka

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Feeding high quality forages is a vital factor to get high production from dairy cattle. However, rainfall is a key limiting factor in Northern region of Sri Lanka resulting lower forage production and higher variations. This field experiment was conducted in Omanthai, Vavuniya (8.8908°N, 80.507°E, annual rainfall 1434 mm, average temperature 27.4^{o}C) during Maha Season (October–December 2018) to study the growth performances and nutritional composition of three fodder crops and identify the most suitable crop variety to the region. Three fodder varieties, Sugargraze (*Sorghum bicolor*), Maize 984 (Zea *maize*) and Nutrifeed/Pearl millet (*Pennisetum glaucum*) were tested in a Completely Randomized Design with 3 replicates. A total of 10 randomly selected plants from each plot were weekly measured for growth parameters (plant height, number of leaves, leaf length and number of tillers) up to 60th days of planting for sugargraze and maize, and up to 45 days for Nutrifeed. Harvested fodders were measured for fresh matter (FM) and dry matter (DM) yield and subjected to the proximate analysis (crude protein, and total ash content). The results revealed that the Sugargraze (*Sorghum bicolor*) showed a higher ($p<0.05$) plant height (252.18±4.5cm) followed by Maize 984 (241.29±3.0cm). However, Maize 984 (Zea *maize*) resulted the highest FM (90.67±0.15 t ha^{-1} cut^{-1}) and DM (26.76±1.39 t ha^{-1} cut^{-1}) contents ($p<0.05$). Nutrifeed/Pearl millet (*Pennisetum glaucum*) was significantly higher in number of leaves (60.00±1.66) and tillers (6.07±0.15) ($p<0.05$) but lowest in FM (30.13±1.69 t ha^{-1} cut^{-1}) and DM (18.76±0.39 t ha^{-1} cut^{-1}). The highest crude protein content was recorded in Nutrifeed (12.65%) in comparison of Maize (6.33%) and Sugargraze (10.16%). Nutrifeed had the highest total ash (10.43%). These findings revealed that maize performed better in growth performances, however nutritive value was high in Nutrifeed cultivated in Omanthai, Vavuniya, Northern region under low rainfall.

Keywords: Growth performance, Maize, Nutrifeed, Nutritional composition, Sugergraze

Effect of Glucose Oxidase on Growth Performance and Meat Quality of Broiler Chicken

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Glucose oxidase act on glucose in the presence of oxygen to produce hydrogen peroxide and D-glucono-1, 5-lactone. The enzyme is produced by certain fungi and insects, and has many commercial applications, primarily as an antimicrobial agent and as a pH balancing agent. This experiment was conducted to study the effect of glucose oxidase on growth performance and meat quality of broiler chicken. A total of 960 day-old, Cobb-500 broiler chicks were randomly assigned into the experiment pens. The treatment (drinking water + 0.025% glucose oxidase) and control (drinking water only) were each replicated six times in separate pens, each pen had 80 chicks. All birds were fed the same commercial feed. Two birds from each replicate were randomly sampled and slaughtered on day 35. Breast meat samples were tested for meat quality traits (pH, colour, water holding capacity, cooking loss, proximate composition) and sensory parameters. Birds fed glucose oxidase had a significantly ($p<0.05$) higher weight gain (1,890g) compared to the control group (1,836g). Glucose oxidase had no effect on feed intakes or feed conversion ratios of the birds. Breast meat from the birds fed glucose oxidase gained poor sensory attributes (color, flavour, taste, juiciness, tenderness, overall acceptability) except odour compared to control group ($p<0.05$). No differences were observed in other meat quality traits and proximate composition ($p>0.05$), except gross energy between the two groups. Gross energy content of the breast meat from birds fed glucose oxidase was significantly ($p<0.05$) higher (5.2kcal/g) compared to that from birds fed only drinking water (5.0kcal/g). In conclusion, glucose oxidase in drinking water resulted in better growth performance in broiler chicken but gained poor sensory attributes in their breast meat.

Keywords: Breast meat quality, Broilers, Glucose oxidase, Growth performances, Sensory attributes

Meat and Meat Product Consumption Patterns and Prevalence of Malnutrition among Advanced Level Students in Kandy District

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This study was conducted to elucidate meat consumption patterns among the Advanced Level students in Kandy district, to examine the prevalence of malnutrition via body mass index (BMI) and to elucidate the correlation between meat consumption and prevalence of malnutrition. A total of 387 Advanced Level students were selected using a combination of stratified, systematic and simple random sampling techniques. A pre-tested structured questionnaire was used to collect the primary data from students. Data were analyzed using descriptive statistics and chi–square test. Results of descriptive statistical analysis revealed that majority of students are meat consumers (92%). Students consume meat mainly because of its nutritive value (41.3%) and taste (29.5%). They consume processed meat products primarily due to the taste (30%) and convenience (25.3%). Majority of respondents consider meat type (38.8%) and freshness (15.5%) before purchasing fresh meat whereas expiry date (28.4%) and meat type (18.6%) before purchasing processed meat products. According to the results, 5.4% of students were underweight and 3.6% students were overweight. Results of chi–square analysis revealed that household income and place of living effected on the frequency of meat and processed meat consumption ($p<0.05$). Purchasing place, types of meat and processed meat they consumed were affected by the household income ($p<0.05$). Furthermore, household income, number of family members, living place, frequently consumed meat/processed meat types, frequency of consumption were effected on student BMI ($p<0.05$). This study concluded that there is a relationship between meat consumption pattern and prevalence of malnutrition. Hence, it can be recommended to conduct awareness programs or seminars on nutritional value of meat and meat products to prevent malnutrition among the school students.

Keywords: Body mass index, Fresh meat, Household income, Processed meat, Underweight

Effect of Dietary Probiotic and Phytobiotic Combination on Growth Performance and Meat Quality Traits of Commercial Broilers

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Probiotics and phytobiotics are feed additives that enhance gut health, improve digestion, absorption and thereby promote performances of humans and animals. This research was conducted to determine the effect of dietary probiotic and phytobiotic combination on growth performance and meat quality traits of commercial broiler chicken. A total of 996 day-old, Cobb-500 broiler chicks were randomly assigned into the experiment pens. The treatment (0.25g of probiotic *Bacillus* spp. and 0.25g of phytobiotics in 1L of drinking water) and control (drinking water only) were each replicated six times in separate pens, each pen had 83 chicks. All the birds were fed *ad-libitum* with commercial broiler starter, grower and finisher feeds. Two birds from each replicate were randomly sampled and slaughtered on day 35. Leg meat samples were tested for sensory parameters, meat quality and proximate composition. Blood serum samples were collected and tested for antibody levels against alpha toxin of *Clostridium perfringens* bacteria. Birds fed growth promoters achieved better ($p<0.05$) weight gain (1,927g) and feed conversion ratio (1.53) compared to the control group: 1,908g and 1.55, respectively. In addition, they had significantly higher ($p<0.05$) sensory attributes: flavour, taste, juiciness and overall acceptability compared to the control group. Raw meat redness (10.3) was lower ($p<0.05$) and lightness (58.8) was higher ($p<0.05$) in the treatment compared to those in control: 12.9 and 54.8, respectively. However, other meat quality traits and proximate composition were comparable between the two groups, except ash content which was higher ($p<0.05$) in birds fed growth promoters compared to control. There was no significant difference in serum antibody levels between the two groups. In conclusion, probiotic and phytobiotic combination in drinking water improved growth performance of broiler chickens and the sensory attributes of the leg meat.

Keywords: Bacillus probiotic spp., Broiler meat quality, *Clostridium perfringens*, Growth promoters, Phytobiotics

A Survey On Factors Influencing the Cow Milk Production in Badulla District

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In Sri Lanka, dairy cattle farming is well known as a key subsector of livestock which plays a significant role in rural livelihood in both economic and nutrition. This study aimed to investigate the current status, constraints and factors affecting on dairy cattle milk production in Badulla district. 382 dairy farmers in 15 veterinary regions were selected by Multi-stage Stratified and Simple Random Sampling. Socio-economic, production and management practices data were collected using pre-tested structured questionnaire. Socioeconomic, production data were subjected to descriptive analysis and Regression analysis was performed to determine the factors affecting milk production. Results showed that 47.5% of farmers operate dairy farming as major income source and majority practiced semi-intensive system (93.97%). Male farmers dominate in dairy farming (57.7%) and an average age of the farmers and experience in cattle farming were recorded as 50 and 20 years respectively. Calves were weaned at age of 6 months and Jersey crossbreed was dominant (86.4%) breed. The highest (9.705±8.28 L/cow/day) and lowest (3.29 L/cow/day) milk productions were reported in Haputhale and Mahiyangana respectively. Best fitted Multiple Linear Regression (R^2=59.63%) predicted, cows in heard, breeds, forage type, feeding method and amount of night feeding, mineral supplement, concentrate feeding and type of concentrate, availability of housing facilities significantly affected on the average daily milk production ($p<0.05$). Low quality forages and seasonality, less success in Artificial Insemination, lack of high yielding animals, high prices of concentrates, less availability of supplements and poor housing condition were frequently reported as major constraints for dairy cattle milk production in Badulla. Proper address to the constrains is a key to improve the status and livelihood of the dairy cattle farmers.

Keywords: Badulla, Dairy, Milk, Production, Socio-economic

Determine The Effect of Fermented Soybean Meal Supplementation into A Diet with or Without Fish Meal On Growth Performance and Meat Quality of Broiler Chicken

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Effective feed formulation is considered as an essential element for broiler growth performance. Fermented soybean meal (FSBM) is a plant derived protein source which comprises with higher nutritional value. Thus, this research was conducted to determine the effect of FSBM supplementation into broiler diet with or without fish meal (FM) on performance and meat quality of broiler chickens. Two hundred fourty day old broiler chicks were randomly assigned into four dietary treatments and each treatment comprised with six replicates. The control group (T_0) received 4% (w/w) of FM and 0% (w/w) of FSBM for booster, starter and finisher diets, respectively. Broilers fed other experimental diets were; T_1 (3% w/w FM, 2% w/w FSBM), T_2 (2% w/w FM, 3% w/w FSBM) and T_3 (0% w/w FM, 4% w/w FSBM) in booster, starter, and finisher diets, respectively. Body weights and feed intake were recorded during the experimental period. In addition, fecal samples were collected to evaluate Moisture, Ash, Nitrogen, Calcium and Phosphorous. In day 41, two birds that near to the mean body weight were slaughtered to measure the visceral organ weights, carcass weights, and, meat quality parameters in each replicate. There was no significant ($P>0.05$) difference on growth performance, meat quality parameters, carcass characteristics and relative organ weights of broilers fed different dietary treatments. The highest Calcium (3.55%) and Phosphorous (1.81%) percentages in feces were recorded from broilers fed T_1 while the lowest Calcium (2.27%) and Phosphorous (1.21%) percentages in feces were recorded from broilers fed T_3 ($P>0.05$).In conclusion, FM in broiler diets can be replaced by FSBM and there were no negative effects in both growth performances and meat quality of broiler chickens.

Keywords: Broiler chickens, Fermented soybean meal, Growth performance, Meat quality

Effect of the Pellet Size on Pellet Durability and Feed Conversion Ratio of Broiler Chicken

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There are enough information reported, to determine the suitable pellet form and its' effect on feed conversion ratio for broilers, not for the pellet sizes. Hence, present study was conducted to determine the effectiveness of three different pellet sizes on feed conversion ratio (FCR) of broilers and pellet durability index (PDI) of broiler finisher feed. Keeping quality of broiler finisher feed was checked for two months under room temperature. A total of two hundred and twenty five 22-day old broiler chickens were randomly assigned into three dietary treatments. Each treatment comprised of three replicates and twenty five broiler chickens were included in each replicate. Broilers were randomly allocated to one of three experimental diets and fed for 14 days in a complete randomized design. The dietary treatments included two different pellet sizes and the existing pellet size as control group; T0 (0.5 cm), T1 (1.25 cm) and T2 (0.2 cm). Body weight and feed intake were recorded during the experiment period. Three sizes of pellets were stored for two months under the same conditions to check the keeping quality of the pellets. Under the proximate composition evaluation, crude protein, crude fat, crude fiber, moisture and ash content were evaluated. Data were analyzed by one way (weight gain, feed intake and FCR) and two way analysis (proximate composition analysis) of variance of Minitab 17 software. The feed intake, weight gain and the FCR of chicken were not affected ($p>0.05$) by dietary treatments. The PDI was not affected ($p>0.05$) by the treatments with time. In keeping quality analysis, there was no significance ($p>0.05$) difference of pellet sizes with time. In conclusion, there were no any effect of the pellet size on PDI and FCR of broiler chicken.

Keywords: Pellet size, Feed conversion ratio, Pellet durability, Broiler chicken

Investigation of Hygienic Practices in Routine Milking and Quality of Raw Milk Supplied by Small-scale and Medium-scale Dairy Cattle Farmers in Doluwa Veterinary Range

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The objective of this study was to evaluate the hygienic practices in routine milking, quality of the raw milk and to determine the effect of mixing morning and evening milk on the overall quality of raw milk in Doluwa farm base. A total of 60 dairy farmers were randomly selected for the study and a survey was conducted using a pre-tested questionnaire. Alcohol stability test with different alcohol concentrations (70%, 75%, 80%, 85%, 90% v/v) and Resazurin test were performed to assess the quality of the milk. Safety of the plastic and aluminum milk containers washed by using either cold water, warm water or cold water with detergents were evaluated by performing aerobic plate count. Majority of farmers in Doluwa Veterinary Range were males at the age of 50-60 years. Majority of farmers (52%) had only primary education. There was no any unhygienic practice observed which had any significant association with the alcohol acceptance level. Milk from majority of the farmers (58%) was accepted with the Resazurin test. Maximum alcohol acceptance level of morning and evening milk had a significant association ($P<0.05$) with mixing of morning and evening milk before bringing into the milk collecting point. Maximum alcohol acceptance level had a significant relationship ($P<0.05$) with results of Resazurin test obtained from morning milk. Swab samples obtained from plastic milking buckets had a significantly higher ($P<0.05$) aerobic plate count than those from aluminum milking buckets. A significantly higher ($P<0.05$) aerobic plate count was observed in buckets cleaned using cold water than in buckets cleaned by warm water, and cold water with detergents. These results indicate that aluminum containers are more suitable than plastic containers for collection of milk. Morning and evening milk should be collected separately at milk collecting points in order to improve the overall quality of milk collected in Doluwafarm base.

Keywords: Hygienic practices, Milk quality, Doluwa, aluminum milking buckets, Resazurin

Prevalence and Antibiotic Susceptibility of Bacteria in Milk from Subclinical Mastitis Cows in Embilipitiya, Sri Lanka

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Several types of bacteria can be present in cow milk due to contaminated sources in the dairy farms and from cows with infected udder like subclinical mastitis. Antibiotics are used to control mastitis and other diseases in dairy cows. However the erroneous usage of antibiotics can lead to increased resistance among bacteria that may have public health implications. Thus, the present study was carried out from January to September 2018 to assess the prevalence, types and antibiotic susceptibility of bacteria from subclinical mastitis cows` milk. A total of 160 milk samples from 40 lactating cows were collected from four dairy farms in Embilipitiya, Sri Lanka. California Mastitis Test was used to detect subclinical mastitis in cows. Bacteria in milk were identified using selective media (MacConkey, Brilliance coliform, Mannitol etc.), colony morphology, Gram staining and biochemical tests (Catalase, Coagulase, Citrate, Urease etc.). Susceptibilities of the isolates were tested against 9 antibiotics using Kirby-Bauer method. Overall, 16 cows were detected with mastitis. The prevalence of mastitis in quarter-wise and animal-wise were 10% and 40%, respectively. Hind quarters (32.5%) were affected than fore quarters (7.5%) while quarter disposition showed significant difference ($P< 0.01$). *Staphylococcus* sp. (38%) was most frequently found, followed by *Bacillus* sp. (31%), *E. coli* (19%) and *Klebsiella* sp. (12%). Bacterial isolates were susceptible to gentamycin (56%) followed by enrofloxacin (44%) and neomycin (38%). Isolates were highly resistant to tetracycline (75%), cloxacillin (69%) and ampicillin (63%). Forty five percent of the isolates were resistant to one or more antibiotics. In conclusion, findings showed that mastitis can reduce the milk quality due to bacterial content. Appropriate farm management practices and prudent use of antibiotics are necessary to ensure consumer safety by producing high quality milk minimizing the risk of resistant bacteria in milk.

Keywords: Milk, Bacteria, Subclinical mastitis, Antibiotics, Resistant

Household Egg Consumption Pattern in Kalutara District

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Sri Lanka has shown a significant consumer demand increment in the egg industry. The egg consumption trend reflects that the consumers are not only considered about the nutritional value of the egg but also concern about other aspects such as health concerns associated with, food safety and animal welfare issues. In this context, it would be useful to analyze the egg consumption behaviour of consumers that could generate important insights about egg consumption trend of the country. Thus, as a pilot study, the egg consumption pattern in the Kalutara district was studied through a consumer survey. A pre-tested structured questionnaire was used in the data collection and a total of 400 consumers were selected by using the stratified simple random sampling technique. Collected data were analyzed using techniques such as descriptive statistics and correlation analysis in SPSS statistical software. This study revealed that the per-capita consumption of eggs in the Kalutara district (111) is lower than the country average (123). About 6% of consumers are not consuming egg in the Kalutara district. According to the results, most of the consumers preferred free-raised egg (81%) than the farm-raised egg (14%) and they also preferred brown egg (61%) over the white egg (32%). These results indicated that consumers tend to believe that the free raised brown color eggs have a greater nutritive value than white color farm eggs. The study further revealed that the consumers' perception on health and nutrition did not significantly affect on egg consumption in the Kalutara district. This finding suggests that the consumers are not much aware on the nutritional and health effects related to the egg consumption. However, monetary concerns significantly affected on consumption of egg in families with a low-level of income. This finding indicates that the price of eggs is an important concern in facilitating egg consumption among low income groups. This study concluded that there is a lack of knowledge in less educated and low-income families regarding animal protein sources for a healthy life. Thus, it will be useful to conduct awareness programs to inform consumers about the nutritional value of eggs, social stigmas associated with egg consumption and related health concerns.

Keywords: Egg consumption, Consumer perception, Kalutara district

Knowledge, Attitude and Practices (KAP) Survey on Processed Meat Products Consumption among Agriculture Undergraduates of Government Universities in Sri Lanka

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KAP survey is a study of a distinctive population to agglomerate information on what is known, what is feel or believe and how deed in continuity to a particular topic. The study was aimed to assess the knowledge, attitude and practices on processed meat products (PMP) consumption among Agriculture undergraduates of government universities in Sri Lanka. Data collection was done by pre-tested questionnaire method and sample size of 370 undergraduates was selected using stratified and simple random sampling techniques. Descriptive statistics and chi-square test were performed for the data analysis. Results of descriptive statistical revealed that, female showed the highest knowledge response than the male (Female 24.48% versus Male 22.98%) on PMP. Majority of the participants (98.1%) consumes PMP. Among them, nearly 58% were not aware about the recommended limit of sodium nitrate for PMP. Chicken sausages (73.78%) were reported as the highest purchasing PMP. However, majority (85.94%) responded that PMP can cause negative effects on health and 56.75% responded that there is a higher chance to get high cholesterol level from PMP. Moreover, 41.35% of participants reported that advertising is the most inducing factor to purchase PMP. Majority of the participants (58.64%) favor PMP with soft texture and intermediate colour (65.40%). Further, 62.16% participants favor to have more pictures over more letters in the label of PMP. There was no significant association between knowledge and nutritional level for PMP ($p=0.21$). Attitude towards PMP among undergraduates significantly affected ($p< 0.05$) on their opinion on healthiness of added chemicals in processed meat products. Quality certificates and preferred form of cooking are the factors significantly ($p<0.05$) affected on the practices of PMP consumption. In conclusion, it is required to implement awareness programs about PMP to improve the knowledge, rectify the negative attitudes/myths and enhance the consumption level.

Keywords: Sodium nitrate, Quality certificates, Cholesterol, Undergraduates, Meat products

Characterization of Goat Production Systems in Badulla District of Sri Lanka

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Goat farming in Sri Lanka has a great potential for improvements, especially in rural economies, since it can be operated with low input levels. Badulla district is considered as a rural area where agricultural activities are predominant. However, the available information on goat farming in Badulla is minimal, limiting the opportunities for further development. Hence, the objective of this study was to characterize the goat production systems in Badulla district. A survey was conducted using 320 goat famers in 15 divisional secretariats of Badulla district using stratified and simple random sampling techniques. A pre-tested structured questionnaire was used to collect data on farmers' general information, herd characteristics, management practices and constraints of farmers. Data were analyzed using Minitab 17 statistical software. The results indicated that goat farming is more popular among Tamil and Muslim communities. Out of total study sample, 76.9% were Tamil and 19.7% were Muslim. Majority of goat farmers (80.6%) had only the primary education. Almost all farmers (99.7%) in the area considered goat farming as a secondary income source. In 91.9% goat farms, herd owner is a male although housewives and children helped in farming activities. Most of goat herds were indigenous (75.6 %) while 24.4% were Jamnapari crosses. The average herd size was 6.65 ±4.70. All farmers rear goats under semi-intensive management system. Although, cut and feed, tethering and free grazing were found as major roughages feeding systems, these can vary in different areas of Badulla according to the resource availability. Around 50.0% farmers used raised slatted floor houses. According to the farmers' perception, lack of goat breeds, less government support and less land availability were identified as main problems in goat farming in Badulla. Therefore, based on proper data, short-term and long-term development plans should be implemented for development of goat farming in Badulla.

Keywords: Goat, Production systems, Badulla, Indigenous, Jamnapari

Sustainable Crop Production Technology

- Crop Production and Improvement
- Crop Protection/Pest and Diseases
- Plantation Crops
- Organic Agriculture/Green Technology
- Sustainable Soil and Water Management
- Crop Physiology/Eco-physiology

Effect of Foliar Application of Calcium Chloride in Mitigating Salt Stress in Tomato Plants

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Salinity in soil adversely affects crop productivity and quality. One of the key constraints of expanding tomato cultivation in Dry Zone of Sri Lanka is high salt concentrations prevails in soil. Calcium plays an important role in plant tolerance to stresses including salt stress mainly attributing to modifications in enzymatic and non-enzymatic antioxidants, osmolytes and metabolites. The objective of this study was to enhance the tolerance of tomato plants to salt stress by exogenous foliar application of $CaCl_2$. Tomato variety "Rajitha" was used for the study. Tomoto plants were either treated with water only, water and $CaCl_2$, NaCl only or NaCl and $CaCl_2$. Each treatment contained five replicates. After 15 days of transplanting in pots, salt stress was imposed by treating soil with 150 mM NaCl weekly. Foliar application of 20 mM $CaCl_2$ solution was carried out at 6-day intervals. Morphological parameters and total chlorophyll content were measured weekly. The growth and yield were slightly declined in plants subjected to NaCl stress. Foliar application of $CaCl_2$ to salt stress induced plants led to improvement in vegetative growth and fruit yield in comparison to salt stressed plants where no $CaCl_2$ was applied. In comparison to $CaCl_2$ not applied NaCl-treated plants, $CaCl_2$ applied NaCl-treated plants showed 40-45% increase in average fruit yield ($p<0.05$), 26-30% increase in number of branches ($p<0.01$), increase in fresh/dry weights of shoot and root ($p<0.05$), 13-19% increase in number of flowers (ns) and 3-4% increase in average height of plants (ns). In conclusion, the data showed positive effects of $CaCl_2$ in improving growth and yield of NaCl-stressed tomato plants. It can be suggested that exogenous application of $CaCl_2$ plays an important protective role in enhancing salt stress tolerance in tomato plants.

Keywords: Calcium, Foliar application, Growth, Salt stress, Tomato

Domestication of Two Edible Wild Mushrooms, *Lentinus squarrosulus* and *Lentinus tuber-regium* from Sri Lanka

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Tropical ecosystems are rich in species diversity of wild edible mushrooms but very few domestication attempts were recorded in Sri Lanka. The objective of this study was to domesticate two wild mushroom species, *L. squarrosulus* and *L. tuber-regium* freshly collected from Sri Lanka and to evaluate suitable growth conditions for both strains. *L. squarrosulus* (M013) and *L. tuber-regium* (LSK005) were collected from Ragama and Matale respectively. Species were morphologically identified initially and to confirm the identification Internal Transcribed Spacer (ITS) region was sequenced. Sequences were verified with available sequences in GenBank and a phylogenetic analysis was performed with reference *Lentinus* sequences. Growth rates of the isolates were determined in four different culture media. Rice grains with 0.5% $CaSO_4$ and corn grains with 1.2% $CaSO_4$ and 0.3% $CaCO_3$ were tested as mother spawn media while rubber and mango saw dust were utilized as the carbon source of the growth media. A commercially available *Pleurotus ostreatus* mushroom strain was used in parallel as a control in each of the above experiments. Results confirmed that the highest growth rates of both wild mushroom cultures were observed on Potato Dextrose Agar. Both the isolates colonized corn based mother spawn medium with a higher mycelial density rate. Out of the two saw dust culture media, both isolates showed a better colonization with mango. *L. tuber-regium* produced fruiting bodies after 70 days of inoculation of culture media whereas *L. squarrosulus* and commercially grown *Pleurotus* produced fruiting bodies after 66 and 63 days, respectively. When two culture media are compared rubber saw dust produced higher yield than mango saw dust based media. In conclusion, both wild mushroom strains, *L. squarrosulus* and *L. tuber-regium* can be successfully domesticated and are potential candidates to introduce to the consumers and commercial mushroom growers in Sri Lanka.

Keywords: Phylogeny, Mother spawn culture

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Investigating the Potential of Using Non-Conventional Materials as Mulches in Tea New Clearings in the Uva Region

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The unavailability of herbicides to manage weeds in tea has been lead to contemplate on cultural weed management strategies. Hence, a field experiment was conducted to investigate the potential of using non-conventional materials as mulches in a tea new clearing at Demodera Tea Estate in Badulla during September to December 2018. Shoots of *Cassia spectabilis (Kahakona)*, *Acacia mangium*, *Megathyrsus maximus* (*Guinea* grass) and Silver/Black artificial mulch were used as treatments and *Mana* grass (*Cymbopogon confertiflorus)* was used as the Control. Each mulch was spread on randomly selected plots each sized 3 × 3.6 m at a rate of 1 kg dry matter m^{-2} and replicated quadruplicate. The rate of ground exposure as a percentage was visually assessed with the decomposition of each material weekly. Weed density (counts per 0.09 m^2) was measured at weekly intervals and the weed dry weight was measured at four weeks intervals. A bioassay was also carried out to study any allelopathic effect of mulches on the suppression of weeds. Tea plant height and diameter were also measured before and 8 weeks after mulching (WAM). Half-life (time taken for the 50% ground exposure) of 8.8, 11.5, 10, 12 weeks was recorded for *C. spectabilis*, *A. mangium*, *M. maximus* and *C. confertiflorus*, respectively. Ground exposure in artificial mulch was remained as zero and weed density was also zero even at 12 WAM. Weed density and weed dry weight were significantly lower in *C. spectabilis* and *C. confertiflorus* treatments and there was also weed growth suppression due to their allelopathic effect. Tea growth was not significantly affected by any treatment. Artificial mulch was found to be more durable and effective than plant based mulches. Although *C. spectabilis* mulch was less durable, the weed occurrence with it was relatively lower than that of other plant mulches.

Keywords: Ground exposure, Mulching materials, Tea, Weed density

Effect of High Temperature on Growth, Pollen Fertility and Yield Parameters of Selected Rice Varieties in Sri Lanka

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Temperature is one of the main environmental parameters affecting growth and development of rice. The mean surface air temperature has increased globally by ~0.74 °C in the last century and will further be increased by ~1.1- 6.4 °C by the end of this century. Therefore, identification and development of heat tolerant rice varieties is an urgent need. This study was conducted to screen twenty rice varieties including newly improved and traditional cultivars for high temperature tolerance based on their growth and yield parameters. Heat tolerant rice variety, N22 was used as the control. The experiment was conducted inside a temperature chamber (35-42 °C) using Randomized Complete Block Design with three replicates for each variety. Eighteen days old seedlings were established with the spacing of 15 x 20 cm as one plant per hill and 40 seedlings per replicate. Growth parameters, pollen fertility, days to 50% heading and 85% maturity, and yield were recorded. Cluster analysis was performed to group the varieties. Accordingly, Kalu heenati was grouped with N22 and was categorized as heat tolerant cultivar. The filled grain percentage and yield per plant of them were 53.5% and 2.19, respectively. Bg 300, Bg 304, Bg 305, Bg 310, Bg 94-1, Bg 352, Bg 357, Bg 358, Bg 359, Bg 360, Bg 366, Bg 369, Suwandal, Pachchaperumal and Pokkali were grouped together and categorized as moderately heat tolerant compared to N22. Sulai, Bg 370 and Madathawalu were grouped together and had the lowest pollen fertility, filled grain percentage and the yield per plant revealing its high susceptibility to elevated temperature. Since none of the tested improved rice varieties were tolerant to high temperature, further research is needed to develop heat tolerant rice varieties for changing future climate.

Keywords: Filled grain percentage, Heat tolerance, Pollen fertility, Rice, Yield per plant

Investigating the Association of Vesicular Arbuscular Mycorrhiza (VAM) with *Commelina benghalensis* Weed Species

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A study was conducted to investigate an association between Vesicular Arbuscular Mycorrhiza (VAM) and *Commelina benghalensis* weed. In field experiment 1 carried out at Wewessa estate consisted of 2 treatments, *i.e.* tea alone and a tea plot infested with *C. benghalensis*. In field experiment 2 carried out at the Uva Wellassa University, tomato was planted as an indicator plant in association of *C. benghalensis.* Single nodal stem cuttings of *C. benghalensis* was planted at 4, 8 and 12 cuttings per plot as treatments. Experiment was undertaken in a randomized complete block design with four replicates. Plant height of tomato and creeper length of *C. benghalensis* were measured weekly. Soil N, P and pH were analysed before and 3 months after commencement and tea yield was measured weekly at Wewessa estate. In both experiments VAM spore counts and root colonization percentages were calculated at 6 weeks' intervals. Dry weights of both *C. benghalensis* and tomato were measured. A significantly higher VAM colony count (19.5) and spore count (21) were reported in the treatment of Tomato planted with 12 *C. benghalensis* cuttings per plot 3 Months After Planting (MAP) when compared to that of Tomato planted with 4 cuttings per plot and the initial root colony count. Phosperous level in the rhizosphere was also significantly (p<0.05) increased when tomato planted with 12 *C. benghalensis* cuttings per plot, 3 MAP when compared to that of tomato planted with 4 cuttings per plot. In the field trial, there was no any significant (p>0.05) difference in tea yield between tea alone and tea planted in association of *C. benghalensis.* The study concluded that there is an association between VAM and P solubilization in *C. benghalensis*. This association has favourably affected on tea and tomato growth.

Keywords: Arbuscular Mycorrhiza (VAM), *Commelina benghalensis,* Root colonization, Soil spore count, Vesicular

Comparison of Chemical Composition and Oil Yield of *Vetiveria zizanioides* from Different Agroecological Regions in Sri Lanka

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Vetiver (*Vetiveria zizanoides*) is a perennial grass used to extract vetiver oil from its roots. Vetiver oil has higher economic value in the international market and mainly used in perfumery, cosmetics industry and known to be a repellent with insecticidal properties. In Sri Lanka, vetiver grasses are mainly cultivated in tea lands to conserve soil and moisture. The quality and quantity of vetiver oil might be vary depending upon different growth conditions prevailed in the cultivated areas but no such reported evidences available. Hence, the objective of this study was to compare the chemical composition and yield of vetiver oil from main tea grown regions of Sri Lanka. Vetiver roots were collected from same age plants by using stratified sampling technique and samples from each stratum were selected randomly from nine agroecological zones including three major tea growing regions (low, mid and high grown). Fine powder from each root sample was prepared separately and 45g of powder used in extractions. Hexane was used to extract the vetiver oil by using Soxhlet apparatus and gas chromatography-mass spectrometry (GC-MS) was followed to analyze the chemical composition. Experiment was conducted in complete randomized design with three replicate and analyzed using analysis of variance. Average yields of the vetiver oils obtained in high, mid and low grown areas were 4.1%, 2.4%, 1.5%, respectively. There is a significant difference between oil yields of high grown and low grown vetiver ($p<0.05$) but no any significant difference between average yield in high and mid grown plants. In conclusion, highest percentage of oil was recorded in high grown vetiver with different chemical composition by showing the greater possibility of commercializing vetiver cultivation in high grown.

Keywords: Chemical Composition, Oil yield, Vetiver grass

Determination of Neurotoxic Pesticide Residues in Vegetables by Using Rapid Bioassay Method

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Pesticide residues in vegetables are determined by expensive and time consuming laboratory techniques. An experiment was conducted to develop a rapid and cost effective protocol for the analysis of pesticide residues in vegetables through Rapid Bioassay of Pesticides Residues (RBPR) method. RBPR is a method that integrates with acetyl cholinesterase (AChE) test to screen the residues of AChE inhibiting neurotoxic pesticides. In this study, 48 vegetable samples (30 non-organic from Kandy central market in Sri Lanka and 18 organics from home gardens) including cabbage, bean, and carrot were tasted for pesticide residues of carbosulfan, diazinon and profenofos using RBPR. AChE was extracted from melon flies (*Bactrocera cucurbitae*) brain using standard protocol and its inhibition was tested. The inhibition of AChE was assessed by determining the reductions of absorbance in contaminated sample after a fixed reaction period. Calibration curves were developed for each pesticide separately and used for vegetable sample testing. Inhibition of AChE by vegetable extracts was analysed. The highest residue levels of carbosulfan, diazinon and profenofos were found in cabbage (0.00 - 0.53, 0.00- 0.44 and 0.00 - 0.58 ppm, respectively) and the lowest values were recorded in carrot (0.00-0.15, 00-0.29 and 0.00-0.21ppm, respectively) although the difference was not significant ($p>0.05$) among vegetables. No pesticide residues were detected in organic samples. Moreover, the cost of sample testing was approximately Rs. 450.00 per sample. This bioassay technique can be used for initial screening of neurotoxic pesticide residues in vegetables as rapid and cost effective technique.

Keywords: Acetyl-cholinesterase, Neurotoxic insecticide, Rapid bio assay method, Vegetables

Development of Microbial Biofertilizer for Tomato (*Solanum Lycopersicum*)

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Extensive application of chemical fertilizers and agrochemicals has led to environmental and health issues, and has contributed to climatic changes. In order to minimize the usage of them, environmental friendly biofertilizers containing inoculants of beneficial microorganisms have been introduced. Present study aims in investigating a microbial biofertilizer for tomato, a vegetable highly dependent on the chemical fertilizers (CFs). Bacterial species living in tomato rhizosphere were isolated in Nutrient Agar medium. Growth medium pH, growth in N free Combined Carbon Medium (CCM), phosphate solubilization, indole acetic acid (IAA) production and lettuce seed germination assay were conducted for them and 8 isolates (J, C, S, F, I, R, B, E) were selected for tomato plant assay. Those isolates were inoculated to soil in tomato planted pots in triplicate. Recommended dosage of CFs for tomato was taken as positive control and a negative control was maintained without adding CFs or microbes. Plant height, number of leaves and flowering were recorded at 10^{th} week and data were analyzed by ANOVA in minitab16.1. The highest clear zone diameter (40 mm) in phosphate solubilization and highest absorbance in IAA were given by isolate C. Inoculants B, R, S changed the colour of CCM into blue, while J, E, I, F, C changed the colour of medium to yellow. In lettuce seed germination assay, the highest vigor and germination percentage were observed in B (246) and F (82%), respectively. All bacterial isolates significantly ($p \leq 0.05$) improved plant height over the controls. The highest mean plant heights were observed under bacterial strains C (93 cm), S (91 cm), F (91 cm) and E (90 cm). Plant treated with C showed the significantly increased leaf number per plant over the other species and the controls. Flower number was highest in E and F treated plants. In conclusion, bacterial strains associated with tomato rhizosphere have the potential to be used as biofertilizers to improve the vegetative growth of tomato.

Keywords: Bacterial isolates, Biofertilizer, Tomato

Evaluation of Rice Grain Quality under Low Moisture and Normal Irrigated Conditions

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Rice grain quality is a combination of varietal characters and environmental conditions. Water is one of the dominant environmental factors affecting final grain quality. Due to climate change, rainfall patterns are changed and no adequate water supplies for crop production which may affect on quality of rice grain. This study was conducted to evaluate the grain quality of selected three rice varieties under low moisture and normal irrigated conditions. Milling performance, physical, cooking and nutritional characteristics of three selected rice varieties; Bg300, Bg14-2448 and Bg304 were measured under both conditions. Results indicated that moisture and carbohydrate contents were not significantly different. Head rice yield, length width ratio, 1000 grains weight, elongation ratio, fiber and protein contents of Bg300 variety were significantly different under both normal irrigated and low moisture conditions. In Bg14-2448 variety, head rice yield and elongation ratio were significantly lower under both normal irrigated and low moisture conditions. Bg14-2448 under normal irrigation resulted highest head rice yield (72.9 g). Bg300 under normal irrigation gave the highest weight of 1000 grains (28.2 g) and high fiber content (3.52%). Bg304 under normal irrigation resulted high protein content (8.66%). Bg300, Bg14-2448 and Bg304 varieties under low moisture condition showed high mean values for elongation ratio compared to normal irrigated condition. There is a decreasing effect of head rice yield, length width ratio, 1000 grains weight, and fiber content from normal irrigated condition to low moisture condition in all tested Bg300, Bg14-2448 and Bg304 rice varieties.

Keywords: Grain quality, Head rice yield, Low moisture, Normal irrigation, Rice varieties

Effect of Open-hole Ratio of Perforated White Polythene Mulch on Growth of Strawberry (*Fragaria x ananassa*)

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Mulching is the best practice that covers the soil to make favourable condition for plant growth and development. Use of mulch has morphogenetic effects on strawberry (*Fragaria x ananassa*) production. The perforated mulch system plays a vital role in the reduction of water accumulation on mulch and it directly prevents the chances of mosquito breeding. Therefore, this study was conducted to assess the effect of the open-hole ratio of perforated white polythene mulch on growth performance of strawberry. An open field experiment was conducted during *Maha* 2013/2014 at Agricultural Research Station, Rahangala. Strawberry variety *'Indian'* was used and it was grown in 2 x 3 m^2 plots under Department of Agriculture (DOA) recommendation with different open-hole ratio of mulching systems: M_1- 0% (covered with solid mulch), M_2- 3.21%, M_3- 6.43% and M_4 (Control)- 100% (non-mulched bare surface). The experiment was laid out in Randomized Complete Block Design with four replicates. Growth parameters such as plant height, crown height, number of leaves, number of runners and maximum root length were measured at two weeks interval. Emergence of weeds per plot was also recorded. The results revealed that, all the adapted mulching systems (M_1, M_2 and M_3) had significantly ($p < 0.05$) higher growth performances than that of the control system (M_4). Ten weeks after planting, plant height (16.1 cm ± 0.07), crown height (3.6 cm ± 0.07) and number of leaves (12 ± 0.4) were greater in M_3 system. In contrast to that, number of runners and maximum root length were greater in M_1 (13 ± 0.6 and 22.4 cm ± 0.6, respectively) and M_2 (12 ± 0.6 and 21.4 cm ± 0.8, respectively). Emergence of weeds were significantly greater in M_4 (261/plot ± 21.6) and less in M_1 (0/plot) followed by M_2 (62/plot ± 4.6) and M_3 (97/plot ± 6.5). Therefore, it can be concluded that, M_3 open-hole ratio of perforated mulching system can be used for growing of strawberry plants.

Keywords: Growth parameters, Perforated mulch, Open-hole ratio, Strawberry

Geospatial Techniques to Slope Risk Rating for Tea Planted Areas in Rathnapura District, Sri Lanka

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Rathnapura district is a one of the severe landslide prone districts in Sri Lanka. Many of the historical landslide records of the district indicates that pre disaster land use of the landslides is with tea plantation. Even though slope is a noteworthy factor for tea plantation, it can be reversely impact due to human induced changes of the land hand in hand with natural environmental causes such as improper land preparedness techniques and scouring or erosion of the toe of the slope. Therefore, the study was carried out for pre determination of risky tea plantation areas in order to propose the areas need possible land use changes. Firstly, a Normalized Differential Vegetation Index map was created in order to identify the spatial distribution of tea plantation in the district. Slope map was created using slope relevant limiting levels for tea plantation, which was identified through Advisory Circular of the Tea Research Institute of Sri Lanka. According to that, slopes of tea plantation are categorized as 0-25% with none risk, 25-70% is moderate risk and more than 70% with severe risk. Final map was created using Fuzzy overlay technique. Slope risk map for tea planted areas indicates that, the highest risk accumulation in Kolonne Korale, Opanayake, Balangoda and Weligepola especially in the Grama Niladhari Divisions of Boraluwageaina, Pupulaketiya, Koppakanda, Welanga, Gawaranhene, Kendaketiya, Pelendakanda and Gangodagama. According to the geometric calculations, Weligepola, Kolonne Korale, Balangoda and Opanayake occupied nearly 1000 acres of risk lands for tea plantation in Rathnapura district. As there are some historical landslide were occurred within tea planted areas in the district, pre determination of risk areas will be important in order to shift on another cultivation or abandon the land rather than triggering mass movement risks.

Keywords: Risk, Slope, Spatial, Tea

Determination of the Variation of Biochemical Profile of Commonly Grown Tea (*Camellia sinensis* (L.) O. Kuntze) Cultivar of TRI 2025 in Low Country Agro-ecological Zones

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There is a unique taste, color and aroma of low country teas compared to other types of tea grown in Sri Lanka. Those properties are governed by the biochemical composition of the tea, basically the tea leaves. However, there was no reported study related to the variation of chemical profile of tea grown in different agro-climatic regions within the low country region. Therefore, this study was conducted to determine the variation of biochemical profile of commonly grown tea (*Camellia sinensis* (L.) O. Kuntze) cultivar of TRI 2025. Fresh tea leaves of TRI 2025 in 5th pruning cycle were randomly collected from eight selected plantations which represent four major tea cultivating agro-climatic regions WL1a, WL1b, WL2a, WL2b in low country. The estates were selected using stratified sampling technique and samples from each stratum were selected randomly from different tea estates in a way of including two estates in each agro-climatic region. The study was conducted during the period of onset of rain, from November to December, 2018. The fresh tea leaves placed on ice immediately after harvesting and transported. The leave samples were dried at 50 ˚C for 12 hours and crushed into fine particles. Chemicals were extracted from each sample using 1g of leaf powder in methanol for the analysis of polyphenols and reducing sugars while phosphate buffer was used for proteins extraction. Folin Ciocalteu regent method Lawry's method and DNS reagent method was used to determine polyphenols, free sugars and total proteins with slight modifications, respectively. This study found that significantly different polyphenol and free sugar contents ($p<0.05$) were in teas grown in the four agro-ecological regions in low country of Sri Lanka but free total protein contents were not shown the significant difference.

Keywords: Agro ecological zones, Free sugar content, Low Country, Polyphenol, Total protein

Investigation of Potential Allelopathic Shade Tree Species for Controlling Weeds in Tea Lands

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Identification of eco-friendly organic weedicides has become a need of the day. There are evidences on some allelochemicals in mature leaves of some shade trees. A study was undertaken to evaluate the bio efficacy of different concentration of mature leaf extracts of shade trees (*Gliricidia sepium, Calliandra calothrysus, Acacia pruinosa, Erythrina lithosperma, Gravillea robusta*) and the most effective extraction technique. This research was conducted as two studies (bioassay and pot study). Mature leaves of selected shade tree species were first oven dried and milled. Leaf extracts were prepared each in four concentrations (20, 40, 60, 80% w/v) using cold and hot distilled water extraction methods. A bioassay conducted using lettuce seeds as the indicator plant. Distilled water was used as the control. Bioassay results revealed no significant difference between cold and hot distilled water extraction methods ($p>0.05$). *G. sepium* at 80% recorded the lowest germination percentage (17.8%) and lowest germination index (0.4) followed by *G. robusta* at 80% (21.9%, 0.5), *E. lithosperma* at 80% (29.5%, 0.6), *G. sepium* at 60% (31.8%, 0.7), *G. robusta* at 60% (39.8%, 0.9) and *E. lithosperma* at 60% (51.0%, 1.1), respectively. Lowest hypocotyl (3.0 mm) and radical lengths (1.8 mm) and lowest seedling vigor index (0.1) was recorded in *G. sepium* at 80%. Based on those results, most phytotoxic extracts (*G. sepium, G. robusta* and *E. lithosperma* each at two different concentrations i.e. 60, and 80% w/v) were selected and further tested on three weed species (*Cleoma aspera, Bidens pilosa* and *Ageratum conyzoides*) planted on pots in three replicates. According to the pot study *G. sepium* at 80% recorded significantly highest dead weed count (*C. aspera*, 100%; *B. pilosa*, 66.6%; *A. conyzoides*, 66.6%) 14 days after applications. Thus, *G. sepium* at 80% can potentially be used to control succulent broad leaf weeds in tea lands. Further investigations are required under field conditions.

Keywords: Allelopathy, Bioassay, Pot study, Shade trees, Weeds

Crotalaria Retusa L. as a Potential Potted Dwarf Ornamental Plant

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Exotic plants are popular in the ornamental plant industry in Sri Lanka due to their attractiveness. However, maintenance cost of these plants are high due to higher water and nutrient requirements. In Sri Lanka though we have a rich flora, native plants are yet to be introduced to the ornamental plant industry that creates advantages than exotics. *Crotalaria retusa*, a native annual herb which bears striking yellow flowers that attracts butterflies in large numbers was identified as a potential plant to develop as an ornamental potted plant. Hence, the present study is an attempt to develop *C. retusa* as a potted plant. Seedlings were raised in black polythene bags in a rain shelter and Paclobutrazol (PBZ) was applied twice as a soil drench with 0.5, 1, 2, 4 and 8 mg per 100 ml concentrations at two weeks interval. Distilled water was used as the control and the pots were arranged in completely randomized design with 15 replicates. Plant height was measured and numbers of leaves were counted in one day interval up to three months in 5 plants per treatment. Leaf colour was measured by using RHS colour chart. Dry weight of shoot, root and leaf of each treatment was measured separately after 12 weeks and the data were analysed by using ANOVA technique. Concentration of 4 mg per 100 ml PBZ exhibited the significantly lowest dry weight and plant height ($p<0.05$) among the treatments. PBZ inhibits sterol and depress the gibberellin biosynthesis which led to the reduction of intermodal distance resulting dwarf plants. However, the concentrations beyond 4 mg per 100 ml, the plant height was not significantly ($p<0.05$) reduced irrespective of the concentration. Increasing PBZ levels progressively increased green colour of the leaves and reduced the size of the flowers. Hence, based on the present study, 4mg per 100ml PBZ could be recommended to produce dwarf potted plants of *C. retusa* for ornamental plant industry.

Keywords: Crotalaria retusa, Native plant, Paclobutrazol, Potted plant

Selection of Climate Resilient Tea Cultivars for Uva Region

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Tea being a highly climate sensitive plant, the climate change drastically affects on its productivity**.** Therefore, an experiment was conducted to identify climate resilient tea cultivars specifically for Uva region. Two standard cultivars (TRI 2023 – drought susceptible and TRI 2025 – drought tolerant) and five accessions (17, 89, 199, 208 and 243 taken from the upcoming series) were evaluated for C stocks, N stocks, yield components and physiological parameters. C stock, N stock, weight of shoots per unit area and dry weight per shoot, photosynthetic rate, leaf temperature, stomatal conductance, transpiration rate, relative water content and water use efficiency were significantly differed among cultivars. The climate resilient ability of these cultivars was statistically analyzed using cluster analysis. Two accessions (199 and 17) were clustered with TRI 2025 showing the highest C and N stocks while having higher dry weight per shoot, weight of shoots per unit area, relative water content and water use efficiency. Other three accessions (89, 208 and 243) were clustered together and appeared in an intermediate group. No any cultivar was clustered with TRI 2023. According to early results, TRI 2025, accessions 199 and 17 can be considered as climate resilient and the accessions 89, 208 and 243 can be suggested as intermediately climate resilient. The climate resilience ability of TRI 2023 is appeared to be very poor. Experiment will be repeated to confirm these results.

Keywords: Accession, Climate, Cultivar, Resilient

Determination of the Variation of Biochemical Properties of Selected Tea Cultivar (*Camellia sinensis* (L.) O. Kuntze) in Mid Country

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In the tea trade, quality is used to indicate the presence of special desirable attributes in the tea liquor which are detected by physical appearance, smell and taste. The biochemical properties of tea is very complex and is currently a subject of broad medicinal and toxicological studies. This study was conducted to determine the variation of selected biochemical properties (polyphenols, free sugars, and total proteins) of commonly growing tea cultivar (Camellia sinensis (L.) O. Kuntze), of TRI 2025 among all tea growing agro ecological regions in Mid Country of Sri Lanka. Fresh tea samples (two leaves and bud) were collected from same aged plants by using stratified sampling technique and samples from each stratum were selected randomly from different tea estates of each agro ecological region in Mid Country (WM1a, WM1b, WM2a, WM2b, WM3a, WM3b, IM1a, IM2a, IM2b, IM3a). Collected samples were placed on an ice and transported and oven dried at 50 ˚C for 12 hours and crushed in to fine particles. Methanol extraction was performed for the analysis of total polyphenol content and reducing sugars while phosphate buffer was used to extract samples for the analysis of proteins. The concentrations of polyphenols, proteins, and free sugars were determined by folin Ciocalteu reagent method, Lowry's method and dinitrosalicylic acid method respectively with slight modifications. The findings of this study shown that biochemical properties of teas such as polyphenol, total protein and free sugars contents were significantly different ($p < 0.05$) among many tea growing ago ecological zones in mid country of Sri Lanka. Maximum polyphenol, free sugar, total protein contents were recorded in WM1b, WM2a and IM2a respectively. Minimum polyphenol, free sugar, total protein contents were recorded in IM2a, IM3a and IM2a, respectively. This sets a precedent for the characterization of biochemical profiles of mid grown tea of Sri Lanka.

Keywords: Agro ecological zones, Free sugars contents, Mid country, Polyphenol, Total protein

Determination of Cadmium Accumulation and Consequent Responses of Four Different Rice Varieties in Sri Lanka

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The heavy metal Cadmium (Cd) is known to be a widespread environmental contaminant in certain parts of the world. Thus, this study was conducted under controlled environmental conditions to identify a Cd tolerant rice variety with low Cd accumulation. The experiment was laid out in Complete Randomized Design with three replicates. Two traditional rice varieties (Pachchaperumal Ac940 and Goda Heenati Ac798) and two new improved rice varieties (Bg 250 and Bg 352) were grown in pots under different soil Cd levels (0.3, 1.5 and 4.5 mg kg^{-1}). The control was maintained without external Cd. The effect of soil Cd on rice plant was measured with respect to plant height, number of tillers, root length, root volume, shoot and root dry weight and flag leaf chlorophyll content. Amount of Cd accumulated in root, stem and leaves were measured using Atomic Absorption Spectrophotometer. For each variety, Accumulation Factor (AF), Bio concentration Factor (BCF) and Translocation Factor (TF) were calculated. At the highest soil Cd level, Pachchaperumal showed a significant increment in root dry weight compared to its control and all other parameters did not show any significant change except the reduction in number of tillers in Bg 250 compared to its control. ($p<0.05$). The highest Cd accumulation on roots and stem were identified in Pachchaperumal and Goda Heenati, respectively ($p<0.05$). No significant difference in Cd accumulation was detected in leaves. The lowest AF (0.72 ± 0.29) was found in Bg 352 and hence it can be identified as a Cd excluder ($AF < 1$). TF and BCF of Goda Heenati (0.24 ± 0.13, 1.0 ± 0.3, respectively) and Pachchperumal (0.04 ± 0.02, 1.0 ± 0.3, respectively) revealed their potential to be used as a phyto stabilizer ($TF < 1$, $BCF > 1$). Moreover, Pachchperumal can be identified as the least affected variety in terms of vegetative growth and hence appeared to be tolerant to above tested Cd levels.

Keywords: Atomic absorption spectrophotometer, Cadmium, Cd accumulation, Cd tolerance, Rice

Effect of Temperature and Packing Material on Germination Rate of Stored Paddy

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Germination rate (GR) of paddy is one of the most important quality standards to obtain a bumper harvest and it is also a key factor to conserve plant genetic resources for long time. Main objective of this study was to determine the effect of storage temperature and packing material on GR of stored paddy for 6 months. Experiment was conducted as a split-split plot design with 3 replicates. Main, sub and sub-sub plot factors were variety, packing material and temperature, respectively. About 5 kg of AT-362 and Kuruluthuda paddy varieties were packed in gunny bags, poly sacks (woven polypropylene) and polyethylene bags (300 gauge) and stored at 4 different temperatures (26, 30, 34 and 38 °C) for 6 months. The germination test was based on 100 grain samples which were drawn monthly for 6 months. Based on the result pertaining to GR after 6 months, 2 factor interaction (Temperature x Packing material) was found to be significant ($p<0.05$). After 6 months, GR of paddy stored in polyethylene bags was significantly lower than that of gunny bags and poly-sacks at every temperatures. The high GR was recorded by AT-362 (93.3%) and Kuruluthuda (92.6%) paddy, stored at 26 °C in poly-sacks, while low GR recorded by AT-362 (8%) and Kuruluthuda (7.6%) at 38 °C when paddy was stored in polyethylene bags. Germination rate of paddy stored in gunny bags and poly-sacks were declined with rising storage temperature and it was significantly lower at 38 °C than the 26 °C. However, there was no correlation between ($p>0.05$) GR and storage temperature when paddy was stored in gunny bags and poly sacks. Germination rate of paddy stored in poly-sacks was higher than gunny bags at all temperatures of the study, but it was not significant. Germination rate showed a negative correlation ($p<0.05$) with storage time when they were stored in gunny bags ($r = -0.830$). It can be concluded that minimum negative effect was found on germination rate when paddy was stored at low temperatures in poly sacks.

Keywords: Germination rate, Paddy, Packing material, Storage, Temperature

Investigation of Possible Vesicular Arbuscular Mycorrhizal (VAM) Associations in Prevalent Weeds in Tea Cultivations of Uva Region

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A study was carried out to investigate the possible Vesicular Arbuscular Mycorrhizal (VAM) associations in some prevalent weeds. VAM association in roots of some weeds is said to be favourable for crop growth. Weed root samples from the rhizosphere of Ageratum conyzoides, Axonopus compressus, Bidens pilosa, *Borreria latifolia*, Cleome rutidosperma, Drymaria cordata, Eleusine indica, Erigeron sumatrensis and Oxalis corniculata were collected from two tea estates, Wewessa and Spring Valley in Uva region covering IM1a agro-ecological zone. Soil samples from the rhizosphere of each weed were collected and tested for soil pH. VAM root colonization percentages and spore counts were calculated using Grid method and Doncaster's counting disc method, respectively. The highest VAM count was recorded as 47.67% with Axonopus compressus weed and the lowest as 20% with Eleusine indica. The highest spore number was counted as 265 with *Borreria latifolia* and the lowest as 70 with Axonopus compressus. The mean pH was within the range of 6.2 to 4.8 at 19 ± 1 °C in two locations.

Keywords: Root colonization, Vesicular Arbuscular Mycorrhiza (VAM), Weeds, VAM spore count

Investigation on Durability of Different Mulches and Their Effect on Weed Growth in Low-Grown Young Tea

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Mulching is an essential cultural practice for weed suppression and conservation of soil and moisture in tea lands. However, this recommended practice has been neglected by tea growers due to scarcity of mulching materials and high cost of labour. Potential use of any plant material as a mulch depends upon its durability. An investigation was carried out to find out alternative plant materials as mulches, which are more durable and available at a lower cost. Shoots of *Diyapara* (*Dillenia suffruticosa),* Flemingia *(Flemingia congesta)* and Acacia *(Acacia auriculiformis)* were selected as mulching materials. These together with artificial agricultural mulch were tested against *Mana grass (Cymbopogon confertifloru).* Plots each sized 3 x 3.6 m in a tea new clearing was covered with each mulch material simultaneously as a treatment at the rate of 1.4 kg m^{-2} on dry weight basis. Experiment was laid out in a Randomized Complete Block Design (RCBD) with four replicates. Results indicated that both *Diyapara* and *Acacia* were found to be more durable recording the highest weed suppression (0.61 kg fresh weight m^{-2}) and the lowest mean weed count,12.7 (0.09 m^{-2}) were presented with *Diyapara*. The highest soil moisture retention (15%) during short dry spells, the lowest soil temperature (26-27 °C) throughout the experiment and the highest C: N ratio of 28:1 was also reported with *Diyapara*. There was no any significant improvement in tea growth between any mulch treatments ($p>0.05$). Further, no any allelopathic effect was manifested by any of mulch materials. *Diyapara* has an ability to suppress weeds more effectively than other mulching materials owing to its high durability.

Keywords: Allelopathy, *Dillenia suffruticosa*, Durability, Mulching material, Weeds

Allelopathic Effect of Weeds Extracts on Growth and Yield of Tomato (*Solanum lycopersicam* L.)

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The weeds are used as mulch, green manure and in compost production that could favourably or adversely affect on crops due to presence of allelochemicals. Such chemicals can be present in any part of the plant and release to microenvironment by leaching, root exudation, residue decomposition and other processes. This study was undertaken to evaluate the allelopathic effect of four common weed species available in agricultural lands on growth and yield of Tomato (*Solanum lycopersicam* L. *var*. Padma) under plant house conditions. The dried vegetative parts of Kura thampala (*Amaranthus viridis*), Bubovitiya (*Clidemia hirta*), Panithora (*Cassia occidentalis*) and Hulanthala (*Ageratum conysoides*) were used to extract aqueous solutions at different concentrations *i.e.* 4%, 8%, and 12%. Aqueous solutions were applied two weeks after transplanting and continued at one-day intervals until harvesting. Three replicates were used for each treatment in Complete Randomized Design with a control (water applied). Vegetative and reproductive characteristics of tomato such as plant height, No of leaves, No of branches, stem girth, total chlorophyll content, No of flowers, No of fruits, and fruit weight were recorded. Total polyphenol content of weed species and variation of soil pH and EC were analyzed in monthly intervals. The application of 4% of Hulanthala was shown the positive performances in vegetative growth, while 12% of Panithora reported the lowest values for both vegetative and reproductive growth of tomato compared to other treatments ($p<0.05$). Further, the highest total polyphenol content was in Bubovitiya and highest fruit weight was reported in the plants treated with 4% Bubovitiya compared to other weed species ($p<0.05$) with the highest brix value. It can be concluded that the weeds such as Hulanthala and Bubovitiya could be used in preparation of compost or in other organic applications at lower concentrations to obtain better growth and yield performances of tomato.

Keywords: Allelochemicals, Reproductive growth, Tomato, Vegetative growth, Weeds

Determination of the Variation of Biochemical Properties of Selected Tea Cultivar (*Camellia sinensis* (L.) O. Kuntze) in Up Country

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Tea has an attractive aroma, good taste, and flavor, however; these properties could vary with climatic factors including temperature, sunshine hours and rain fall prevail in different agro-ecological zones in the growing areas. Therefore, this study was conducted to evaluate the chemical composition of Tea (*camellia sinensis* (L) O. Kuntze) var. TRI 2025 grown in different agro-ecological zones in Up-country. Fresh tea samples of TRI 2025 (two leaves & bud) were collected from the same aged plants by using stratified sampling technique from 11 regions, *viz*: WU1, WU2a, WU2b, WU3, IU1, IU2, IU3a, IU3b, IU3c, IU3d, and IU3e in the up country during the onset of rains. The fresh tea leaves were placed on ice immediately after harvesting and transported. The leaves were dried in an oven at 50 ^{o}C for 12 hours and dried samples were crushed in to fine particles. Methanol extraction was performed for the analysis of total polyphenol content and reducing sugars while phosphate buffer was used to extract samples for the analysis of proteins. The concentrations of polyphenols, proteins, and free sugars were determined by Folin Ciocalteu reagent method, Lowry's method and Dinitrosalicylic acid method respectively with slight modifications. The findings confirm that chemical properties of tea in up country showed significant (p<0.05) difference among many tea growing ago ecological zones in Up-country of Sri Lanka. Maximum polyphenol, free sugar, total protein contents were recorded in IU3e, WU3 and WU1 respectively. Minimum polyphenol, free sugar, total protein contents were recorded in WU2a, IU3a and IU3c, respectively. This study sets a precedent for the characterization of biochemical profile of all tea growing areas in Up-country of Sri Lanka.

Keywords: Agro ecological zones, Free sugars contents, Polyphenol, Up-country, Total protein

Attitude of Government Agricultural Officers towards Organic Agriculture in Sri Lanka

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Organic agriculture is a method of farming, which leads to the sustainable agriculture. Before educating farmers on organic agriculture, relevant government agricultural officers should have better knowledge and positive attitude towards it. The main objectives of this study were to study the level of knowledge of agricultural officers on organic agriculture and their attitude towards it. A sample of 120 agriculture officials was randomly selected from Badulla and Ratnapura districts for the study. A field survey was conducted using a pre-tested questionnaire to gather information from the sample, during the period of April 2017 to May 2018. A few descriptive statistical methods and Chi-square test were used to analyze the data. Results revealed that, majority of the agricultural officers are male, educated up to GCE advance level and have certain level of experience on organic agriculture. While, most of them (81.6%) have a general level of knowledge about organic agriculture, a few of them (29.2%) have a better knowledge on it. According to the mean analysis, most of the officers have a positive attitude towards organic agriculture depending on five important factors *viz.* existing knowledge on organic farming ($\overline{x}$=3.83), environment protecting ($\overline{x}$=4.16), health enhancing ($\overline{x}$=4.33), marketing potentials ($\overline{x}$=3.59) and social enhancing ($\overline{x}$=4.30). According to Chi-square test, there was no association between demographic factors and the attitude of the agricultural officers. However, they have lack of awareness on organic agricultural policies. But, promotion of organic agriculture mainly depends upon the knowledge and skills of agricultural officers. Therefore, motivating them to acquire more knowledge and education on organic agriculture is timely important to establish a sustainable organic agricultural systems in the country.

Keywords: Attitude, Government agricultural officers, Organic agriculture, Sustainable agriculture, Sri Lanka

Present Organic Farming Policies and Future Needs: A Review Paper

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Organic agriculture plays a very significant role in meeting the food production requirement and sustainable development in Sri Lanka. As a country with full of natural resources, Sri Lanka has a great potential to fulfill the considerable portion of ever-growing market demand for organic products in the world. Sri Lankan communities also have a strong natural inclination towards traditional agriculture. Thus, this research was conducted to study the problems of organic farming, existing policies on organic farming, policy gaps and suggest future policy needs and strategies. Research papers, journal articles, project reports and survey data were used to gather information and they were summarized under each objective. Results revealed that although most of the Sri Lankan farmers have background knowledge about traditional organic farming, by now only a small number of rural farmers practice it in small scales. Thus, as a whole, Sri Lanka is still in the initial stage with regard to organic farming. Also the expected outcomes of organic agriculture are different among the various stakeholders and no adequate solutions to address certain issues in the sector. Even though Sri Lankan government has formulated policies for agriculture, there is no proper policy framework for organic farming in the country and it is still in its initial phase. Thus, the necessary background including policies and programs for the development of modern organic farming in the country targeting the export market is at a poor state and encouragement from the government compared to many other countries is also at a lower level. Therefore, provisions of the institutional support required for organic agriculture in terms of providing scientific basis of organic practices are timely important.

Keywords: Conventional agriculture, Organic farming, Organic farming policies, Sri Lanka

Growth, Physiological Attributes and Yield of Selected Groundnut (*Arachis hyogaea* L.) Cultivars Affected by Moisture Stress during the Flowering Stage

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Drought being the most important environmental stress severely impairs plant growth, limits plant production and the performance of crop plants more than any other environmental stress factors. An experiment was conducted at the Agronomy farm of the Eastern University, Sri Lanka during the *Yala* 2017 to determine the effects of drought on the growth physiology and yield of selected groundnut cultivars. Indi, Lanka jumbo and Tissa groundnut cultivars were used for this study. Polyethylene bags were filled with topsoil, red soil and compost and one hundred and ninety-two bags were used. Moisture stress was imposed for a period of ten days by withholding the water continuously during the flowering stage. The control plants were watered to Field Capacity at two days interval. This experiment was laid out in the Randomized Complete Block Design with six treatments (T_1, T_3 and T_5 were control, T_2, T_4 and T_6 were moisture stressed) and four replications and the treatments were arranged in 3×2 factor factorial design. Moisture stress has significantly ($p< 0.05$) reduced the measured physiological growth attributes in terms of chlorophyll content, Leaf Area Index and yield compared to the control treatment. The highest values of chlorophylls a (0.98 mg g^{-1}), b (0.79 mg g^{-1}) and total chlorophyll (1.7 mg g^{-1}) were obtained in the groundnut cultivar Indi and the lowest (Chl. a- 0.5 mg g^{-1}, Chl. b- 0.3 mg g^{-1} and total Chl.- 0.9 mg g^{-1}) were found in Tissa. The highest Leaf Area Index (0.58) was obtained in the groundnut cultivar Indi and the lowest (0.33) was found in Tissa. The highest yield (0.8 t ha^{-1}) was recorded in the cultivar Indi and the lowest (0.3 t ha^{-1}) was found in Tissa under moisture stressed condition. Hence, this study revealed that Indi groundnut cultivar has shown better growth performance and yield than the others when exposed to moisture stress during the flowering stage. As such, this cultivar could be suggested in the arid parts of the Eastern province.

Keywords: Chlorophyll content, Groundnut, Leaf area index, Moisture stress, Yield

Unmanned Arial Vehicles (UAV) in Smart Agriculture: Trends, Benefits and Future Perspectives

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There is an improved concern in precision farming and the development of smart systems for agricultural resources management aims to increase the agricultural productivity, optimize the profitability, and protect the environment. Data collection, field variability mapping, decision making, and management practices are the foremost stages of smart agriculture. Self-directed aircrafts are sophisticated cost effective instruments for data acquisition, real time thermal images to the Ground Control Station (GCS), and the best medium for quick time and critical analysis of the crop growth. Unmanned Arial Vehicles (UAVs), especially drones, can fly autonomously with dedicated software which allows making a flight plan and deploying the system with Global Positioning System (GPS) and feed in different parameters such as speed, altitude, Region of Interest (ROI). These features are required in smart agriculture where large areas are monitored and analyses are carried out in minimum time with miniaturization of compact cameras and other sensors like infrared and sonar. UAVs are presently being functional by farmers in extensive field analysis of crop behavior such as rice, maize and wheat where they scan through the field, take images and report abnormality. The collection and delivery of images in a timely manner, the lack of high spatial resolution data, image interpretation and data extraction issues are the major limitations identified in the applications of remote sensing systems in agriculture. Nevertheless the future of agriculture is clear with drones as a precious tool that will amplify profitability and healthy crop production. Further, it has been predicted that the agriculture sector will be the second largest user of drones in the world in the next five years. Research priorities and future challenges that will support in the development of effective use of UAV in agriculture with multi-prong strategies were discussed.

Keywords: Drones, Global positioning system, Remote sensing, Smart agriculture

Effect of Type of Growing Medium on Growth and Productivity of Greenhouse-grown Cucumber (*Cucumis Sativus* L)

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Controlled Environment Agriculture is the latest technology in Agriculture and Japanese Cucumber (*Cucumis sativus* L) is cost effective crop that can be grown with this technique. Use of inappropriate soilless culture media causes weak growth, nutrient deficiencies and low yield in hydroponic cultivations. To eliminate these problems, finding and recommendation of a good media is really beneficial. Therefore, this experiment was done to study the growth and yield performances of Japanese cucumber as affected by different media with Albert's solution under controlled environment. The present experiment was carried out in Ruhuna model Farm, Gamudawa site, Kumburupitiya. There were 12 treatments and 4 replications for each treatment. Both growth and yield parameters were taken into consideration, such as height of the vine, leaf area of 5^{th} and 14^{th} leaves, number of leaves per vine, time taken to first flowering, total yield per vine, and number of fruits per plant and pulp pH. All parameters were significantly different from each other ($p<0.05$). Significantly highest average yield per vine (5863.5 g) was observed in treatment 4 (Coco peat x partially-burnt paddy husk x Granite chip contained medium. Thus, Coco peat x partially-burnt paddy husk x Granite chip contained medium can be used as potting media with Albert's solution as supplement to increase yield of Japanese cucumber.

Keywords: Cucumber, Hydroponics, Yield

Adoption of Eco-Friendly Technologies in Paddy Farming in Sri Lanka as an Alternative to Chemical Fertilizer: Exploring the Farmer Perceptions

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There is a greater interest among scientists to develop Eco-Friendly Technologies (EFTs) for paddy farming, from one hand, to reduce chemical fertilizer usage, and to safeguard food supply and ecosystem health, on the other. This paper explores the attitudes and perceptions of farmers that trigger them to use certain EFTs produced such as ('slow release fertilizer', 'organic carbon', and 'microbes') produced through a multi-phased project funded by National Research Council of Sri Lanka. These EFTs were incorporated into the root ball of the rice plant at the nursery stage and then healthy seedlings were planted in the field by using the 'Parachute Technique' method (*i.e.* alternative technology to other modes of seed establishment including 'broadcasting' and 'transplanting'). Farmers from Anuradhapura and Kurunegala districts (n=80) were selected to collect data in terms of farmer attitudes and perceptions linked with six key criteria related to these EFTs including: (1) 'Regulation'; (2) 'Cost'; (3) 'Environment'; (4) 'Performance'; (5) 'Services', and (6) 'Acceptance'. The possible effects of each criterion were written in the form of attitudinal statements and supported by a 10-point likert-scale. The scores provided by farmers on each statement were subjected to the tests on Scale Reliability and Unidimensionality and then used to derive Aggregate Mean Scores. Results suggested that, 'Parachute Technique' was better than broadcasting with respect to Regulation (-1.44), Environment (-2.49) and Performance (-1.57). The farmer perception on parachute technique was 'poor' only for Service (0.19) when compared to transplanting. The outcome of the analysis highlights the importance of generating private and market-based incentives for farmers as potential end-users to encourage adoption of EFTs in paddy cultivation. Further, availability of related services and facilitative institutional framework will have a direct impact on the adoption of such EFTs.

Keywords: Attitudes and perceptions, Chemical fertilizer, Eco-friendly technologies (EFTs)

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Climate, Technology and Variations in Profit in Tea Production: A Study on Nuwara Eliya Tea Estates

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Tea is the major foreign income earning crop in Sri Lanka and its GDP contribution is 2% while the 65% of export agriculture revenue and 15% of foreign exchange earnings is also obtained through the tea industry. Also, about 20% of population depends directly or indirectly on the tea sector. The sustainability of this industry depends on its profitability and if not sufficiently profitable, these tea lands maybe converted to other uses in time to come. As predicted by climatologists, future weather is expected to be different from the present. Therefore, the main purposes of this study were to investigate the variability in profits among tea estates and to see weather, climate and technology influence this variation [risk]. This study was carried out in Nuwara-Eliya district because, it is the largest tea producing district in Sri Lanka as well as Nuwara-Eliya teas have high foreign demand. Nuwara-Eliya district consists with two tea growing regions which are Dimbula and Nuwara-Eliya; therefore, when selecting the sample variation of the agro ecology was considered. Data collection followed a stratified random sampling procedure. Twenty-three year's production and climatic data were collected from thirty-five estates were used in the analysis. Variance of the error term of the estimated profit function was assumed to be related to risk. Annual total rainfall, annual maximum and minimum average temperature were taken as the climatic variable while technology change was represented by a time trend variable. According to the result of this study, all weather variables showed 'U' shaped relationship with the variance. According the results the minimum variability in profit is obtained when the optimum annual rainfall is around 2000 mm, the annual maximum average temperature was 21 ˚C and the annual minimum temperature was 12.25 ˚C. Therefore, estate sector needs adaptation strategies for weather as well as possible changes in the climate that is bound to happen.

Keywords: Climate change, Nuwara-Eliya district, Profit risk, Tea estate, Technology changes

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Determination of Economic Injury Level and Economic Threshold Level of Tobacco Cutworm (*Spodoptera litura*)

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Total eradication of *Spodoptera litura* in tobacco cultivations is virtually impossible and is usually undesirable because it can spell the demise of the pests, natural enemies and can upset the broader economic balance. This experiment was conducted to find out the Economic Injury Level and the Economic Threshold Level of *Spodoptera litura* in tobacco cultivations. The equation, EIL = C/VD'K where C = management cost per production unit, V = market value per production unit, D' = damage per unit injury, and K = proportional reduction in injury with management, was used to find the EIL and the equation, ETL = EIL-(EIL/2) was used to find ETL. In determination of damage per unit injury, four uniform tobacco seedlings were grown in each treatment plot with three replicates and laid out in a Randomized Complete Block Design. Plants' exposure time period to the pest was considered as the treatments where the second instar larvae which were mass reared in a culture cage, were introduced at the rates of 0, 5, 10, 15 and 20 to the treatment plots having exposure times of 0, 5, 10, 15 and 20 days, respectively in the 22nd day after transplanting. Pest damage was quantified in terms of damaged leaf area. The management cost per unit production was calculated by taking both pesticide cost and application cost into account. Damage per unit injury was calculated as 1.56 and the management cost per unit production unit was calculated as LKR 4.92. Proportional reduction in injury with management was 0.8 and the market value per production unit was LKR 450.00. Upon substitution of the values in the variables of the formulas, the EIL of tobacco cutworm was determined as 8.76 larvae per 1000 plants and ETL was calculated as 4.38 larvae per 1000 plants.

Keywords: Economic injury level, Economic threshold level, Spodoptera litura, Tobacco cutworm

Effectiveness of Organic Fertilizer Produced from Tannery Buffing Waste

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Buffing dust is Chromium containing solid waste generated during the leather processing which is considered to be a hazardous material and therefore, a proper treatment before discarding to environment is vital. Dechroming process eliminates the potential toxic Chromium (Cr^{+6}) to non-toxic form (Cr^{+3}) through chemical hydrolysis. Therefore, this study was carried out to develop an organic fertilizer from the buffing dust and study the effectiveness on Radish (*Raphanus sativus* L.) growth. Trials were conducted at Ceylon Leather Products PLC and in an experimental field located at Kaduwela, Colombo. Collected samples of buffing dust (3 kg) were subjected to chemical hydrolysis consisted of four steps and conditions for each step were optimized as follows, (20 g per 10 L sodium hydroxide and 400 g per 10 L urea for 0.5 h at 40 °C, 500 g per 10 L sulfuric acid solution for 1 h at 40 °C, 400 g per 10 L CaC_2 suspension for 2 h at 30 °C and 500 g per 10 L sulfuric acid solution for 1 h at 30 °C). The final product was characterized by peptide and free amino acids and Cr^{+3} level was estimated using Atomic Absorption Spectrophotometry as 365.1 ppm. Field trials were conducted against Radish (*Raphanus sativus* L.) with four treatments of developed fertilizer (15, 30, 45 and 60 g,) and positive and negative controls under Completely Randomized Design. Vegetative growth (number of leaves, plant height and leaf length) were measured in weekly interval. Results revealed that 60 g fertilizer mixture showed significantly ($p<0.05$) higher vegetative growth; number of leaves (7.0 ± 1.4), plant height (18.8 ± 4.3 cm) and leaf length (9.8 ± 2.4 cm) compared to other treatments and control groups. Results concluded that buffing waste can be simply converted to an organic fertilizer and effectively used to enhance the plant's vegetative growth which might finally reduce the possible environmental hazards due to improper discards of Cr tannery waste.

Keywords: Buffing waste, Chromium, Organic fertilizer, Radish (*Raphanus sativus* L.),

Evaluation of Grafting Technique for *Garcinia quaesita* Pierre. (Garcinia) by Using Different Wrapping Materials at Different Maturity Stages of Root Stock

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Garcinia, which is commonly named as *Goraka* (*Garcinia queasita* Pierre.) has growing demand at present due to its remarkable medicinal value with anti-obesity properties**.** Limited cultivations are exist due to unavailability of quality planting materials. Seed propagation is possible, but low germination percentages, recalcitrant nature of the seeds, long juvenile of the seedlings, seasonal flowering behavior and polygamously dioecious nature are main limitations. This study was conducted to identify the best maturity stage of rootstock and the best wrapping material for grafting of Garcinia in plant propagation. Three different maturity stages; three, five and seven months old seedlings in stem diameter of 1.5, 2.5 and 3.5 cm, respectively were selected along with four different types of the wrapping materials; Polysack twine, Parafilm, Normal polythene (100 guage) and Cling film. Cleft grafting and Complete Randomized Block Design (factorial) were used in three humid chambers with eight replicates. The data were analyzed using two-way ANOVA. Relationship between maturity stage and wrapping material on success rate of Garcinia was determined. There was no any interaction effect between maturity stage and wrapping material on success percentage of grafted plants. The maturity stage was significantly affected on success percentage and survival rate of grafted plants the highest success percentage was observed in five months old seedlings as rootstock and it could be recommended as the best maturity stage for grafting of Garcinia.

Keywords: Garcinia, Cleft grafting, Maturity stage, Rootstock, Wrapping material

Travel & Tourism

- Tourism Development and Cultural Heritage Management
- ICT and Smart Tourist Destination Management
- Consumer Behavior in Travel and Tourism
- Service Quality Management in Travel and Tourism
- Human Resource Development in Travel and Tourism
- Tourism Impacts
- Destination Marketing and Management
- Tourism Planning and Passenger
- Alternative Tourism Promotion
- Transportation Management

The Impact of Destination Attractiveness on Tourists' Motivation to Consume Local Foods: Empirical Evidence from Ella and Nuwara Eliya Tourism Zones

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Although the food is an imperative aspect of the tourism industry, there are limited studies on tourists' motivation to consume local foods at tourist destinations. Thus, this study concerns the destination food brand image towards the local foods and tourists' motivation to consume local food based on different destination attractions. To identify the relationship between destination attractiveness, destination food brand image and motivation to consume local food; to uncover the impact of destination attractiveness to motivate the tourists' local food consumption and to elucidate how destination food brand image mediates the destination attractiveness and motivation to local food consumption were main objectives of the study. Three hundred tourists who visited Ella and Nuwara Eliya were selected using convenient sampling technique and a self-administered questionnaire was fielded to collect primary data. Five underlying factors were analyzed under destination attractiveness; of local food consumption were labelled: cultural experience; authentic experience; food health; sensory appeal; and physical excitement. The study reveals that destination attractiveness as well as, a destination food brand image, can significantly enhance tourists' motivation to consume local food. Marketers required identifying the ways that they can develop destination food brand image, food service providers required to develop relevant skills to produce local foods with better taste, smell, appearance and they should use quality and fresh ingredients to maintain the food healthiness. Based on the results it can conclude that tourists taste local foods while travelling and communication is more important to motivate them by promoting and establishing destination food brand image in their minds.

Keywords: Motivation, Destination food brand image, Tourism, Local food consumption, Destination attractiveness

Identify the Potentials to Promote Special Interest Tourism in Kurunegala District: With Special Reference to Cultural Heritage Tourism

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Cultural Heritage Tourism is the type of Special Interest Tourism and is one of the fast growing segments in Tourism. This trend is evident in the rise in the volume of tourists who seek adventure, culture, history, archaeology and interaction with local people. Kurunegala boasters with four ancient kingdoms in its periphery bearing a significant historical importance. The cultural quadrangle Program established under the central cultural fund is also based on these four ancient kingdoms namely, Kurunegala, Yapahuwa, Dambadeniya and Panduwasnuwara. But up to now it is not a district which popular among foreign tourists. The objective of this study is identifying the potentials to promote Kurunegala as Cultural Heritage Tourism destination. One hundred foreign tourists, who are visiting Cultural Heritage Sites in kurunegala District, were selected using convenient sampling technique and self-administered questionnaire was distributed among tourists to collect primary data. Descriptive analysis is used to identify the visitor profile of potential cultural heritage tourists to destination. Researcher identified location's Cultural heritage attractions, Location's Environmental features and its attractions, Basic Tourists' needs, supporting services as destination attributes to promote the Cultural heritage tourism by using Exploratory Factor Analysis. The most significant attribute is Location's Cultural Heritage Attractions. Tourism Itineraries together with all destinations and its attractions in kurunegala district, logo and slogan for the district, Plan the tour packages including kurunegala, communicate uniqueness of the destination can be recommended to promote the destination attributes identified. Since Location's Cultural heritage attractions are most significant, Researcher recommends maintaining preserved and clean sites, excavating more past historical works and implementing sound signage and naming system.

Keywords: Potentials, Special interest tourism, Cultural heritage tourism

Time Series Analysis for Modelling and Forecasting Tourist Arrivals in Sri Lanka

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For centuries, Sri Lanka has been a popular place for foreign travelers. Tourism and Hospitality industry is one of major source of income in Sri Lanka which directly contribute to Country's economy. Therefore, understanding and forecasting the upcoming trends of tourist's arrivals is really important and it will be beneficial and important for stakeholders and interesting parties of the country. The purpose of this research study is to investigate and forecast the tourist's arrival in Sri Lanka using time series modelling based on past available data from January 1995 to January 2018. The data has been analyzed based on the two sets: pre-war (1995-2010) and post-war (2010-2018) due to major variations in the Tourism and Hospitality industry after the civil war in 2009 in Sri Lanka. In this study Auto Regressive Integrated Moving Average (ARIMA) method and Multiplicative Decomposition Approach (MDA), are proposed for forecasting. When the forecasts from these models were validated, post-war data has more accurate results having low mean absolute percentage error for MDA than ARIMA approach. Furthermore, Comparison between predicted and actual data also confirmed that the MDA model from post-war data represent high predictive ability.

Keywords: ARIMA, MDA, Time series, Tourist arrival, Forecast

Sustaining Resident Support for Tourism through Empowerment: An Inquiry Based on Resident Empowerment through Tourism Scale

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Sustaining resident support is critical for successful tourist destinations. Researching resident attitudes towards tourism is the base to initiate a destination's development. Though, empowerment is decisive in attitude, quantitative researches that employ standardized scales to operationalize empowerment across diverse communities show a dearth in Sri Lankan context. This study utilizes Resident Empowerment through Tourism Scale (RETS) to model empowerment's role in sustaining residents' support for tourism in the light of Social Exchange Theory (SET) and Weber's theory of Formal and Substantive Rationality (WFSR). It predicts the validity and reliability of RETS model, in demonstrating how empowerment predict the overall support for Tourism Development through impacts they view in positive and negative dimensions. Kalpitiya, a fast developing tourist destination in the Island was found a fertile ground to test the proposed model. A randomly drawn sample of 300 residents was used to collect primary data through a self-administered questionnaire. Data was analyzed using Structural Equation Model approach in Smart PLS. Findings show that residents are influenced by personal economic benefits and pride, self-esteem heightened by psychological empowerment. Capability of raising a voice boosts political empowerment and influences on positive impacts leading to residents' support for tourism development. It emphasizes the fact that formal and informal approaches of empowerment can exert a great influence on the general support of residents towards tourism. Paper argues that SET merely insufficient to explain residents' behaviour towards tourism while WFSR appears as a broader approach. This study contributes to strength the formal and substantive rationality factor interpretation that inherent in the complex process of modelling residents' attitudes toward tourism development.

*Keywords***:** Community empowerment, Tourism impacts, Residents' support for tourism, Resident Empowerment through Tourism Scale (RETS), Kalpitiya

A Study on Tourism Undergraduates' Satisfaction on Internship Experience and Their Future Career Intention

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The national universities have integrated student internship experience in to the tourism and hospitality curricula, recognizing its importance for improving employability skills, developing knowledge and inculcating positive attitudes of the undergraduates. Hence, this study attempts to examine the satisfaction level of the tourism and hospitality undergraduates with the internship experience and its impact on their future career intention. A structured questionnaire was utilized to collect data from the undergraduates of Rajarata University of Sri Lanka, who have minimum two months internship experience. Random sampling technique was employed for data collection and a total of 56 were received for the final analysis out of 86 questionnaires distributed. Descriptive statistics have been used to analyse the level of satisfaction of undergraduates with regard to internship experience and regression analysis was employed to analyse the impact of internship experience on their future career intention. Training program, nature of work, supervisors, facilities, co-workers and future career intention are the concerned areas for this study. The dimensions used for this study are reliable at the level of 0.7. The result reveals that the undergraduates are satisfied with their internship experience in terms of all the dimensions excluding facilities provided by the training organizations and all the undergraduates intend to work in the industry after graduation. The finding also shows that the undergraduates' satisfaction with respect to the training program and the nature of the work significantly impact on their intention to work in the tourism industry in the future. Hence, to attract the undergraduates to the industry after the graduation, it is advisable for the managers of the tourism and hospitality establishment to provide proper training during the internship period considering the factors such as proper orientation, on the job training, working hours, and workload.

*Keywords***:** Tourism undergraduates**,** Internship experience, Career intention

A Study on Marginalization of Indigenous Minorities: Evidence from Vedda Community in Sri Lanka (With Special Reference to Dambana and Rathugala)

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Tourism is one of the massive industries which contribute significantly to the global economy. Indigenous tourism has been identified as one of the promising sectors in Sri Lankan tourism industry. This research study is designed based on the concept indicator model reflecting three research objectives. The study strives to uncover whether the marginalization of *Vedda* community by enforced means or it is voluntarily occurred. Qualitative research approach was entrusted through in-depth interviews covering 18 respondents including both *Vedda* people and other stakeholders at Dambana and Rathugala areas. The study assesses the determinants of marginalizing areas in public life, is the *Vedda* Marginalized or not and the role of tourism in the *Vedda* life in the above context. Qualitative data collected were analyzed using thematic analysis. Findings of the study revealed that, social, economic and political aspect as the marginalization areas of the *Vedda* community by enforcing or voluntary means. Self-esteem and tourism dependence are determinants of the degree of marginalization where both enforced and voluntary means are in action the process of marginalization *Vedda* community. Consequently, the current study concluded that among the majority of selected participants among the Vedda community and stakeholders, the *Vedda* community has been marginalized mainly by voluntarily in Sri Lanka. Based on the in-depth data collected, it is identified that they are playing major role in the Sri Lankan tourism industry within their own sociocultural framework. Finally, this study suggests the government and other authorities to pay more attention on the indigenous minority to promote the Sri Lankan tourism industry by taking necessary steps and actions while focusing on the preservation of their vanishing cultural values.

Keywords: Voluntarily marginalization, Enforced means, *Vedda* Community, Stakeholders, Cultural and heritage tourism

Global Sustainable Tourism Standards and Certification Schemes: How Transnational Private Meta-Governance Operates at the Destination Level

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Voluntary sustainability standards and certification schemes have proliferated in the tourism and hospitality industry. This has created what is referred to as "a fragmentation problem," in which too many self-governing actors set regulatory standards and certifications for sustainable tourism. It eventually led to the rise of meta-governance, i.e., a means and mechanism by which to coordinate standards setting and certification processes for tourism firms and destinations. Within the framework of meta-governance as an increasingly important form of governance, this study focuses on the mechanism in which the Global Sustainable Tourism Council (GSTC) plays a pivotal role as a private meta-governing body. Furthermore, it investigates how the private meta-governance system has been put in practice at the destination level by analyzing the multifaceted function of Green Destinations, one of the two private certifying bodies accredited by the GSTC. Semi-structured interviews were conducted with key informants in the Netherlands, Slovenia, and Japan. Along with the interviews, field observations were carried out in certified destinations which received awards to identify the factors that have contributed to enhancing sustainability of these tourist destinations. The findings revealed that the distribution of voluntary sustainable standards and certification programs is geographically skewed with more than half of the certification programs being located in Europe. Moreover, it was found that leading certification programs have obtained GSTC accreditation, which has enhanced their credibility and legitimacy as certifying bodies. Finally, but most importantly, the successful operation of meta-governance was found to be dependent on vital functions provided by private intermediary organizations such as Green Destinations, who work in close contact with local green coordinators.

Keywords: Private meta-governance, Certification, Global sustainable tourism council, Green destinations

Role of Tourist Motivation in Shaping Destination Loyalty; Study on Asian Tourists in Sri Lanka (Special Reference to Colombo Region)

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Asian travel market generates a large portion of profits and it constitutes a large market segment inside the entire tourism industry in Sri Lanka. This study focuses on how Asian traveller Motivation influences in shaping the destination loyalty in Sri Lanka. The model describes that the examination of the effects of motivation and satisfaction on destination loyalty and the theoretical and empirical evidence on the causal relationship among the variables. Proposed model investigate that the traveller motivation is the independent variable and under that there were two sub independent variables namely, push motivation and pull motivation. Destination Loyalty Depends on the prior variables and the traveller's satisfaction acts as the mediator variable. Research is mostly based on Primary data and researcher used convenience sampling to collect data from 200 Asian tourists visit Colombo region by using self-administrated questionnaire with consisted of 40 questions. Causal relationships investigate by using the SPSS and Smart PLS. The finding reveals that Majority of the Asian tourists were from the China, India and Japan. As push motivation Fulfilling prestige or achievements was significantly impacted for Destination Loyalty. From the pull motivational factors Interesting town and village are significantly impact on the destination loyalty. The Structural Equation Model, identify the relationship between travel motivation and traveller satisfaction and relationship between the traveller satisfaction and destination loyalty. Maximize the Asian tourist's awareness about the Sri Lankan culture, traditions, Historical attraction places and lifestyles via travel webs, increased focusing more on novel cultural experiences, make sure to ensure the safety and security of the tourists' without ethical harassments, implement the new policies and publish those among the Sri Lankan community are the basic findings of this research.

*Keywords***:** Asian tourists, Traveller motivations, Traveller satisfaction, Destination loyalty

Study on the Influence of Marketing Mix Factors on the Revisit Intention of Inbound Tourists (With Special Reference to Nuwara Eliya)

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Revisit intention has been a key focus in tourism research since it is critical in tourist destination marketing. Studies reveals that in tourism industry, retaining a customer is ten times profitable than attracting a new customer. Maintaining a satisfied tourist is pivotal to shape their revisit intention as literature proposes in this field. Marketing mix is critical in any form of attracting and retaining tourists for a destination leading to a successful tourism destination. This research focuses on service marketing mix elements or the 7P s' including product, price, place, promotion, physical evidence, personnel and process and how the marketing mix impact on revisit intention of inbound tourists with special reference to the Nuwara Eliya. By identifying the most influencing marketing mix elements that impact on tourists' revisit intention; stake holders, government, other responsible bodies and the relevant policies can be make effective changes for attracting and retaining tourists. A conceptual framework has been developed based on the 7P's in service marketing. The convenience sampling method was used to collect the data from the 200 inbound tourists who visited five different destinations in Nuwara Eliya; as in Hakgala Botanical Garden, Gregory Lake, Victoria Park, Hortain Plains and New Zealand Farm. Pearson correlation analysis and the multiple linear regression analysis were used to analyse the data. The analysis of this research implies that there was a positive relationship between all the marketing mix factors and inbound tourists' revisit intention and the results revealed product, price, personnel and physical evidence are highly impact on the inbound tourists' revisit intention in Nuwara Eliya. Implementing proper destination management systems, standardizing the quality of destinations, spreading tourism with unique cuisines and launching standard level of promotions are the findings of this research for retain the existing tourists.

Keywords: Service marketing mix, Inbound tourists, Revisit intention, Tourism, Sri Lanka

Destination Image and Destination Loyalty: Comparison between Asia Pacific and European Tourists

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Sri Lanka is full of natural and man-made attractions and things that can attracts many of tourists towards them from different regions in the world and Tourist satisfaction has been identified as a key performance indicator in tourism industry. According to the SLTDA 2016 report, Sri Lankan tourist arrival markets are move from Western Europe countries to Asian countries. In this respect, this study attempted to explore the difference between these two major source markets in the context of Destination Image and Destination Loyalty to advise the Destination Management efforts of the country. The researches done by scholars suggest that there is a significant positive relationship between Destination image and Tourism satisfaction. Key objectives of the study include identify the role of destination image on the destination loyalty among the Asia Pacific and European tourists and identify the difference between destination loyalty among Asia Pacific and European tourists. Research data were collected using convenience sampling method with 180 tourists 90 from each both regions visit to Western province by distributing self-administrated questionnaires. Questionnaire consists with four major parts and 35 questions from two dependent variables and mediator variable. Results obtained from using Descriptive analysis and PLS-SEM model. Findings revealed that tourists from both regions were highly satisfied with the existing level of cognitive destination image and affective destination image on Sri Lanka. Both region tourists have an effect on Cognitive Destination Image through Perceived Value and only Asia Pacific tourists have an effect on Affective Destination Image through Destination Loyalty. Western Europe tourists are effect on Cognitive Image, Affective Image and Perceived Value through Destination Loyalty. Therefore, researchers recommended improving the Affective Image facilities among Destination Loyalty in Asia Pacific tourists.

Keywords: Destination image, Destination loyalty, Asia pacific tourists, Europe tourists

Potentiality of Implementation of Revenue Management Techniques in the Travel Agency Operations

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Revenue Management (RM) was popularized globally over the decades as an essential strategy in optimizing revenue in most of the capacity limited industries. The concept was originally derived from the airline industry and it was used not only as a mechanism to increase revenues but also to satisfy the customers' needs. Airline, hospitality and recreational industries, and many of other service sectors except travel agencies, have been successfully applied RM approaches. Highly competitive and unpredictable challenges in the travel agency operations have created the need of applying new strategic approaches to maximize the revenue due to the higher operational costs and reduced profit margins of Sri Lankan travel agencies. Key objectives of the study include examining travel agents 'perception on Revenue Management applications in the travel industry, examining the nature of RM practices of travel agencies and identifying the barriers of RM implementation in Sri Lankan travel agencies. A sample of 13 travel agencies from Colombo district was selected for the study based on purposive sampling technique. Structured interview method was applied to investigate perceptions, potentiality of implement as well as barriers of implementation. Collected data was transcribed and analyzed using thematic analysis. Results of this study show that, Sri Lankan travel agencies are not familiar with the term of RM and have limited knowledge about RM approaches. All participants have positive perception on RM approach. The benefits of RM applications, advantages of RM to the travel agencies and facilitating factors that need for travel agencies, also were stated in this study. Based on the findings, researchers recommended improving the knowledge on RM approaches, benefits and application of RM approaches among Sri Lankan travel agencies.

Keywords: Revenue management, Travel agencies, Benefits and barriers, RM implementation, Profits maximizing

Enhancing Community Involvement in Wildlife Tourism - A Focus on Challenges and Issues (With Special Reference to Wasgamuwa National Park)

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Tourism is a sector that can contribute to the economic growth of any region. Sri Lanka has proved to be one of the fastest growing tourist destinations for many types of tourism and specially wildlife tourism. This research mainly focuses on the challenges & issues faced by host community leading to limit their involvement in wildlife tourism. The study aims to clarify and enhance community involvement in wildlife tourism in economic, rural livelihood and social cohesion perspectives. The study also identifies the expectations of community members in order to enhance their involvement in wildlife tourism. Research site is Wasgamuwa National Park, one of the famous wildlife park in Sri Lanka, mostly locals and foreigners visit to experience the wildlife tourism activities such as safari, camping, photography. The extensive review of literature on wildlife tourism, protected areas, community involvement in wildlife tourism, hosts perception on wildlife tourism, barrios to satisfactory host engagement with wildlife tourism and the way forwards for hosts and wildlife tourism have enhanced the theoretical background of the study. Semi-structured interviews were conducted to collect primary data from the community members. Local service providers, government officials and host community around Wasgamuwa National Park were interviewed and their views and opinions are used as the basis for analysis from which findings are elucidated and recommendations made. Qualitative data have analyzed through thematic analysis using NVivo11 pro software. By using thematic analysis method researcher identified the themes in the data set. The findings show that a huge current involvement of the community in wildlife tourism. Researcher showed Maintaining access to resources, Complimenting and boosting livelihood, Active participation not just involvement, Cooperation with the private sector, Exploiting the market through ecotourism label as the recommendations.

Keywords: Wildlife tourism, Host community, Community involvement, Wasgamuwa national park, Challenges & issues

Integrated Marketing Communication as a Tool to Promote Heritage Destinations in Sri Lanka; With Special Reference to Anuradhapura Ancient City

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Heritage tourism is one of most prominent areas of tourism in the country. Heritage destinations of Sri Lanka face ever increasing competition from other South & Southeast Asian countries. Integrated marketing communication is selected as a potential promotional method for heritage destinations and it will be able to gain a competitive advantage over other competitors. Integrated marketing communication is the process of combining all the marketing communication method to send a consistent massage to end consumers with using most effective methods. Anuradhapura was the first capital of Sri Lanka with a history close to 2500 years. Recent tourism growth of the area was much slower compared to other heritage destinations in the country. Hence, the purpose of the study was to identify existing IMC channels influencing heritage destination promotion, to identify most effective IMC channels for promotion of heritage destination and to examine IMC as a tool to promote heritage destinations in Sri Lanka. Primary data was collected by the author from 100 foreign tourists using convenient sampling technique and 10 tourism stakeholders were interviewed using purposeful sampling technique in Anuradhapura ancient city. Explanatory Sequential Mixed Method was employed and descriptive statistics and thematic analysis were used in analysing of the data. The findings of the study revealed that integrated marketing communication can be used as a promotional tool for heritage destinations in Sri Lanka. However it has to be conducted sensibly with fixed set of goals. Clear tourism strategies, increase the use of new media platforms and promotional methods, decrease the use of conventional methods of promotions and implementation of private & public partnership were essential for an effective use of integrated marketing communication.

Keywords: Heritage destinations, Integrated marketing communication, Anuradhapura

The Impact of e - Marketing Mix Elements on European Tourists' Tour Package Selection Decision.

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Travelling was an essential factor of everyday life of people from ancient to modern day. There are lot of different methods and types of travelling. With the introduction of new communication and technologies, travel has become easier, cheaper and safer. As a result of this, travelling for pleasure purposes have rocketed in recent past. People with similar interest and who are familiar with each other tend to travel together. Considerable amount of people get middleman to make easier, safer and cheaper of the tour for them to travel. This marks the increase of purchasing tour packages. There are many travel agencies and tour packages available to tourists. To gain a competitive edge and survive in the market, a travel agent has to must implement a careful marketing strategy. In the last two decades conventional marketing methods has dropped and electronic marketing has become the primary method of marketing. Since e - Marketing is critical in modern marketing, the main purpose of this study to identify the impact of e - marketing mix elements on European tourists' tour package selection decision. A conceptual framework has been developed based on previous researches to identify the relationship between e - marketing mix elements and tourists' tour package selection decision. The research mainly depends on primary data collected through European packaged tourists. Convenience sampling method used to collect data from 200 European packaged tourists who visit Anuradhapura, Ella, Hikkaduwa and Yala. Descriptive statistics, coefficient of correlation analysis and multiple regression analysis used to analyze the data collected. Results disclosed all e - Marketing mix elements have positive relationship with European tourists' tour package selection decision.

Keywords: e - Marketing, Travel agencies, European tourists, Tour package selection

A Study to Assess the Relationship of Brand Image and Brand Loyalty of Ceylon Tea Brand (With Special Reference to Southern Province)

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Ancient Sri Lanka is also known as Ceylon. The name "Ceylon" is still famous all over the world. Most of Sri Lankan products use the name Ceylon, as their brand for reach to the international market and make a strong recognition. Ceylon tea is one of them. Ceylon tea is world's most popular tea brand with 150 years of history. The true taste of Ceylon tea always stays in the heart of the tea lovers. Brand image is an important factor in any product, service or organization. Strong brand image assist to attract more new customers and to retain exist customers by making a loyalty to the brand. Customer buying behaviour is directly depends on the brand image. Therefore, brand image is highly valuable for any kind of product. This research is mainly focus to find out the relationship between brand image and brand loyalty of Ceylon tea brand. The conceptual framework has been developed based on the brand image attributes. The data for the study is mainly collected by the primary data through questionnaire survey. The data was collected from 245 international tourists who interested in Ceylon tea with special reference to the southern province. Multistage sampling technique has been used for the study and researcher has used seven destinations including, Hikkaduwa, Galle Fort, Unawatuna, Ahangama ,Mirissa, Weligama and Tangalle. Further, the data was tested by using the SPSS software by applying the techniques of descriptive analysis, correlation analysis and multiple linear regression analysis. The results revealed that all four brand image attributes, as awareness, proper position, credibility and uniqueness have individual positive impact on the brand loyalty of the Ceylon tea brand. Among these attributes uniqueness is mostly impact on brand loyalty. In order to develop the Ceylon tea brand in all over the world, brand image concepts can be recommended based on the brand loyalty of another province or country as whole with a proper strategic framework.

Keywords: Brand image, Brand loyalty, Ceylon tea

Impact of Entrepreneurs Self - Efficiency on Tourism Industry Firm Performance (With Special Reference to Ella Area)

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Self-efficacy is often an overlooked, but critical component to successfully completing a task in the workplace. The relationship between self-efficacy and performance is critical and lays the foundation for how each owner interacts with his work and what he is capable of achieving. Further, the level of self-efficacy of the individuals also can differ among individuals. Accordingly, past studies shown mix findings on the relationship between self-efficacy of owners and firm performance. The aim of this study is to investigate the impact of self-efficacy of Entrepreneurs on firm performance. More specifically, study examined whether there is any variation in self-efficacy in terms of gender differences of the owners. The study investigated four major dimensions of self-efficacy in general (vicarious experience, physical state, previous result, Feedback). A sample consists of 90 owner managers in Ella Area and simple random sampling method was adopted to select the respondents. Further, this study employed self-administered questionnaire to collect data. Besides, the data were analyzed by using descriptive, correlation, multiple regression analysis and one-way ANOVA. Results significantly supported to conclude that self-efficacy is one of the strong predictors of firm performance and there is a strong positive relationship exists between self-efficacy and firm performance. Besides, the results revealed that the owners in Ella Area were highly possessing the emotional arousal self-efficacy compared to other dimensions. Additionally, females are low self-efficacious than males and their performance is significantly low. However, there is no difference in the level of self-efficacy and firm performance in terms of age and education level. It is suggested that the owner managers should develop their talents, organize themselves to be effective and be motivated to perform better

Keywords: Self-efficiency, Firm performance, Entrepreneurs

Factors Influencing Urban Tourism Development in Kandy City

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Mass tourism has been dominating the global tourism sector until recent past. However, due to changing consumer expectations and extensive competition, countries are seeking new strategies to improve their tourism activities in the country. Nowadays tourists proffered to move from mass tourism to niche tourism. . Urban Tourism is one such new concept which is has become important in the backdrop of increasing urbanization. This research study uses "Urban Tourism" as a concept to identify the influencing factors to the development of urban tourism in Kandy City. This study carried out with both quantitative and qualitative methods. After the comprehensive literature review, structured questionnaire was constructed with 23 items and the survey was conducted. The target sample of this research is tourists who are visiting to Kandy City. 200 tourists visiting Kandy city were surveyed to collect primary data for the study. Initially, descriptive analysis was carried out to screen the respondents' profile. Subsequently, factor analysis was carried out to reduce number of variables and to group factors which have similar characteristics. Thematic analysis technique was used to analyze opportunities and barriers to develop urban tourism in Kandy city. The study identified five factors which significantly influence urban tourism development in Kandy City. Those were People most perceived attractions, People most perceived amenities, Tourists most expected activities, Accessibility and security and Government involvements. In order to identify opportunities and barriers, this study used qualitative method and data collected from government authorities who are involve in tourism sector. Also through this study have been identified more attraction palaces were the best opportunity and Lack of underdeveloped infrastructure facilities were the major barrier for the urban tourism development.

Keywords: Urban tourism, Niche tourism, Factor analysis

Impact of Ecological, Communal, and Economic Attitudes on Residents' Support for Sustainable Tourism Development; Evidence from the Residents' of Sinharaja Rainforest Periphery

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This study aims to identify the Impact of Ecological, Communal, and Economic Attitudes in shaping residents' support for Sustainable Tourism Development in an ecologically sensitive tropical rain forest periphery in Sri Lanka. A Self-administered questionnaire was to a conveniently drawn-sample to collect primary data. . A total of 270 completed questionnaires were collected from the residents around Sinharaja Rain Forest, in Sri Lanka. Residents' perception of ecological sensitivity, community attachment, economic assertiveness, and sustainable tourism development support were used to run the proposed theoretical model using Structural Equation Modelling (SEM) technique, Smart PLS was used as the tool and the results revealed that community attitudes had a significant positive effect on ecological sensitivity, and personal economic gains had a positive effect on socio-cultural understanding, also positive tourism impact had a significant positive effect on sustainable tourism development. According to the results of this study socio cultural understanding had a significant negative effect on attitudes of negative tourism impacts. The results of the SEM revealed that four of the 11 hypothesized paths in the proposed structural equation model were acceptable and another seven were rejected. For Descriptive statistic SPSS software were used to analyse the data and results revealed that males were highly participated to the tourism industry and also other demographic informations of this study were widely spread. This study was conducted by considering only quantitative approaches to analyses the findings therefore based on the limitations of study future research can study qualitative approach to interpret the findings in depth.

Keywords: Tourism impacts, Sustainable tourism development, Community attitudes, Resident support for sustainable tourism development, Sinharaja rain forest.

The Impact of Destination Image on Foreign Tourist Future Behaviour Special Reference to Bentota in Sri Lanka

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The impact of the Destination image being an important factor in decision making process of tourist future behaviour of revisiting and recommendation. Selection of a destination to be revisit or recommend to others would base on the tourist's perceived value on the destination. Considering that, this study mainly aims to identify the impact of destination image on foreign tourist future behaviour in Sri Lanka. The theoretical dimensions of destination image; Cognitive image, unique image and Affective image were adopted in order to accomplish the objective of identifying the impact of the destination image on foreign tourist future behaviour. Bentota was selected as the research area for the study as the arising of tourism harassments, negative practices of beach boys, overcapacity of the coastal region which would create a bad destination image among the tourists, have become a major issue on the location. The population was the international tourists visited Bentota area, in the months of May, June, July in 2018. 300 respondents were selected as the sample employing convenient sampling technique. The adopted questionnaire of (H, 2008, Hailin Qu,2011, and Artuger, 2017) was used as the research instrument for collecting data. The collected data was analysed by employing Smart PLS software version 2.0 and SPSS. The results revealed that there is the most significant and effective positive relationship among the cognitive image and the foreign tourist future behaviour. While Affective image has no significant relation between the foreign tourist future behaviour and Meanwhile, Unique image has a significant negative relation between the future behaviours of the tourists. Hence, it suggests to develop the destination through niche tourism concepts based on the target markets and their perceptions of visiting. This study derives theoretical and empirical contribution and need for further researches on the context.

Keywords: Destination image, Cognitive image, Unique image, Affective image, Future behaviour

The Impact of Internal Marketing on Employee Performance: Mediating Role of Employee Commitment in Travel Agencies in Colombo District

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Employees are the blood stream of any business. The accomplishment or disaster of the firm depends on its employee performance and how much they are committed towards the work. There are fewer researches done in the context of Sri Lanka and travel industry regarding internal marketing, employee performance and employee commitment. Therefore this study aimed at studying the impact of internal marketing on employee performance and mediation of employee commitment. The objective of this study was to identify the relationship between variables and the role of mediation of employee commitment. Data were collected through a random sample of workers in selected SLTDA registered travel agencies. 200 copies of the designed questionnaire were distributed and 178 copies of the questionnaires were recovered. Descriptive statistics were used to assess the employee profile, correlation to identify the relationship between variables, simple regression to identify the impact of one variable on the other and process Model 4 to identify the mediating effects. According to the descriptive statistics most of the employees who work in travel agencies are young and middle aged, educated and high income earners. The relationships between variables show positive relationships and internal marketing shows a significant impact on employee performance. The effect of mediation of employee commitment shows a negative value that denotes a non-mediation relationship between internal marketing and employee commitment. The researcher concludes that there is a relationship and direct impact of internal marketing on employee performance and there is no mediating effect of employee commitment. Therefore the researcher recommends that to improve the internal marketing practices such as training, motivation, empowerment and communication in organizations, in order to achieve high employee performance.

Keywords: Internal marketing, Employee performance, Employee commitment, Travel agency

Impact of Social Networking Sites Service Quality on Travel Decision of International Tourists (Special Reference to Sri Lanka)

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It is a well-known fact that travel and tourism industries are highly inter-related, despite the concepts focus on two different aspects. According to literature, social media has been recognized as one of the main factors which greatly influenced travel decision of international tourists. The main objective of the paper is to analyse the impact of social networking sites on travel decision making behaviour of international tourists visiting Sri Lanka. Data were collected from 200 tourists who visited Colombo and Galle districts of Sri Lanka by using a structured questionnaire. Furthermore, convenient sampling technique was applied to select the sample. A regression analysis was carried out to accomplish the objectives of the study and results reveal that there is a strong positive relationship between the influence of social networking sites service quality and travel decision making behaviour of international tourists. Moreover, 'Motivation' has been identified as the most influential dimension under the independent variable which needs to be improved further to influence the travel decision making behaviour of tourists. Social media marketing campaigns, online competitions and blogging in social networking sites about destinations and attractions of Sri Lanka could be recommended to influence the decision to visit and also to act as a motivation factor in travel decision making by the international tourists.

Keywords: Service quality, Social networking sites, Travel decision, Tourism

Tourists' Experience Mapping After Visiting a Post-Conflict Destination Using TripAdvisor.com Reviews: The Case of Jaffna, Sri Lanka

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Although tourists' experience is a popular research paradigm, studies on identifying tourists' experience after visiting a post-conflict destination is of rare. The present study is central to a post-conflict destination, Jaffna, which was remoted to the rest of the world for nearly three decades due to the armed conflict between Sri Lankan government forces and Liberation Tigers of Tamil Eelam carders. Jaffna, being an infant tourist destination, now increasingly being frequented by both local and international tourists. Modern tourists, who heavily rely on the social media, generate new trends for the millennium travels. The tourist experience is now being popularly published in social media web sites by the means of E-word of mouth. Therefore, with the aim of understanding tourists' experience after visiting a post-conflict destination, the present study adopts an exploratory case study method to analyse tourists' reviews on Tripadvisor.com. Two hundred fifty-one reviews were selected from key thirteen tourist destinations in Jaffna during the second and third quarters of year 2018. The data were analysed using the qualitative content analysis and thematic analysis to identify the main themes that were common in the data set by using N-vivo 11 by QSR International. The thematic analysis process recognized four distinct characteristics of the tourists' experience in visiting Jaffna: attractions, tourists, destination attributes and political. Finally, the study forwards implications and management recommendations to develop tourism in Jaffna.

Keywords: E-word of mouth, Qualitative content analysis, Social media, Thematic analysis, Tourist experience

Local Economic Impact of Marine Tourism in Hikkaduwa, Unawatuna and Mirissa area

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Marine tourism is a niche tourism concept and it can be identified as a sustainable alternative to mass tourism and as a means of providing benefits to local communities. Marine tourism is a kind of Ecotourism. According to those studies and statistical data reports, there is positive tourism impact on Sri Lankan economy mainly through the increased employment, revenue generations and rural facilitation. But there are an empirical gaps and knowledge gaps regarding the local economic impact of Marine tourism in Sri Lanka. So this study is attempted to fill those empirical gap and knowledge gap by examining the local economic impact of marine tourism in rural area of Hikkaduwa, Unawatuna and Mirissa. Hence the objectives of this study are to identify the economic impact of marine tourism on local communities around the coastal area and to identify the level of distribution of economic impact among the local communities in Hikkaduwa, Unawatuna and Mirissa area. This study used small-scale survey methods to examine the local economic impacts of marine tourism and distribution of impacts among local communities arising as employment, rural facilitation and revenue generation within those three areas where 100 tourists, 100 employees and 100 owners of the marine tourism related business entities were surveyed. Descriptive statistics and regression techniques were employed as the major analytical techniques of this study. Results suggest that marine tourism industry in those areas has positive impact on local economy and those economic impacts are retained within local areas rather leak aging from the rural economies. Hence marine tourism in Hikkaduwa, Unawatuna and Mirissa area has the significance contribution to the surrounding local economy, through employment, revenue generation and local development by removing the barriers to the Ecotourism of Distributional inequality and External dependency.

Keywords: Distributional inequality, Ecotourism, External dependency, Local economy, Marine tourism

Preferences and Attitudes of the Tourists Towards Alcohol Availability and The Policies in Sri Lanka

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Annually tourists arriving in Sri Lanka has increased up to 14% in 2016. This growth is important and should be maintained for national development. Recent proposals suggest that access to alcoholic drinks for tourists should be increased by reducing tax and increasing access points. A further warning given was that without increasing access for alcohol Sri Lanka is likely to loss many tourists in coming years. Therefore, this study focused on collecting firsthand evidence from tourists to determine the relationship between tourist's arrivals and the opinion of tourists in relation to access to alcohol. Interview administered data was collected from 302 tourists 18 to 78 years of age, from 38 countries, from 9 cities where tourists visit the most. Participants for the survey were selected randomly from hotels, restaurants and while visiting places. Only 1% enjoyed having beer in the pub/hotel. Only 2% suggested access to alcohol should be increased. Difficulty of having a drink and not being able to smoke in public places was 2.6 and 1% respectively. More than 90% agreed on the policies banning of public drinking and smoking. Interestingly, number of participants highly appreciated it and stated that it was a life changing opportunity for them to change their smoking and drinking habits. The main reason to revisit Sri Lanka was nature, history and culture. Around 5% will revisit because they love the food while none of them stated they will revisit to go to clubs or for night life. Only 1.5% participants say that they will skip revisiting Sri Lanka as they have problems in obtaining alcohol in some places. It is evident that access to alcohol or availability of alcohol has not been seen by tourists as a problem and it has not been affected in their decisions to revisit Sri Lanka.

Keywords: Tourists, Alcohol, Policies, Alcohol availability, Alcohol accessibility

Potentiality of Fashion Industry for the Tourism Development in Sri Lanka

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Today many tourists from all over the world specifically visit fashion cities to explore fashion related elements such as participate in major fashion weeks, fashion forums and exhibitions, consume branded and unique fashion products and so on. These fashion elements can be seen in this tropical country Sri Lanka along with the unique and extraordinary manufacturing techniques. Sri Lanka is globally recognized as the tourism destination with unprecedented natural beauty, beaches, wild life, culture and art and crafts. The art and craft play a major role in promoting Sri Lankan beauty to the world; it represents our culture, natural beauty, wild life and traditions. Fortunately, this remarkable craftsmanship was adopted by Sri Lankan fashion industry many years ago that led to create great masterpieces inspired with Batik, handloom, lace and so on. Colombo is the major hub for fashion since it's consisted with major fashion design institutes, national and international fashion weeks, origin of talented fashion designers and major fashion boutiques. The focus of the study was to examine the linkage between fashion and tourism in the city of Colombo and its tourism potentials. The research analysed existing situation of fashion industry and the potential of fashion industry to promote Colombo as a fashion city. This study unveiled the challenges and opportunities involve in fashion industry to contribute for the tourism development in Sri Lanka. In order to justify the potentiality of fashion industry for the tourism development, all the evidences and data was collected from experienced and famous fashion designers, major fashion week organizers, Export Development Board and Sri Lanka Tourism Promotion Bureau through semi- structured interviews and the conclusion was given after going through the thematic analysis. The conclusion of the study emphasized the fact that there is a huge potentiality for the fashion industry to make a vital contribution to tourism development in Sri Lanka by promoting Colombo as a fashion city. But this depends on proper framework for the fashion industry a tourism industry, financial support by the government to all the stakeholders of fashion and tourism industry and effective marketing and promotional efforts that are consistent.

Keywords: Fashion tourism, Cultural and creative industry, City branding fashion city, Tourism development

Community Based Tourism as A Tool for Rural Economic Development in Hiniduma Area

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Tourism can make a significant impact on rural communities as the customer comes to the facility or product creating a room for direct selling/engagement for the host communities. Accordingly community based tourism emerged as a possible solution to the mass tourism in developing countries, which thus became a strategy for communities in order to develop rural economies. Therefore, this research exploited the opportunities for rural economic development through community based tourism in Hiniduma area and identifying the most influencing challenges when developing community based tourism as a new concept. The research adopted the quantitative approach to data analysis, especially using multiple regression analysis. The primary data were gathered by using standard format questionnaires. The sample consisted of 120 respondents who are engaging with different kind of community based tourism activities in Hiniduma. The major objective of the study is to identify the potentials for rural economic development through Community based tourism in Hiniduma. The result of the analysis indicates that, there is a higher potential for rural economic development through Community Based Tourism. In addition in that study include two hypotheses. According to hypothesis testing researcher identified that there is an impact on Socio economic factors to the rural economic development. As the second objective of research aimed at identifying the most influencing challenges for CBT.The study found that lack of knowledge about CBT concept, lack of e-commerce awareness, lack of financial support from financial institutes, lack of family members support, and also lack of money to invest as the major challenges in developing community based tourism in Hiniduma. As recommendations author proposed develop agro tourism, volunteer tourism, nature based tourism in hiniduma and river Gin can use as a major option. Furthermore responsible parties should give attention to the major challenges.

Keywords: Community based tourism, Rural economies, Rural economic development, Socio economic factors

Role of Destination Attributes on Domestic Tourists' Revisit Intention Towards Wetland Parks of Sri Lanka (Special Reference to Wetland Parks in Colombo District)

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Wetland parks have been identified as an alternative travel destination for domestic tourists in general and a major recreational space for urban Travellers. Tourism scholars have concentrated on repeat visitation as an antecedent of destination loyalty. The tourists assess their intention to revisit a certain destination or preference based on the results derived from interplay of multiple factors. However, the scholars have contradictory findings of determinants of revisit intention of tourists. Hence, the purpose of the study was to identify the existing level of destination attributes and revisit intention of the domestic tourists, to identify the relationship between destination attributes and Revisit intention of the domestic tourists and to recognize most significant attributes influence on revisit intention of domestic tourists in wetland parks. The primary data was collected by the author from 240 domestic tourists using convenience sampling technique and questionnaire consist 42 questions from main three sections. Quantitative data analytical method was employed in analysing the data using Descriptive statistics, correlation and multiple linear regression analysis. The Finding reflects that there is a strong positive relationship with destination attributes and Revisit intention of the domestic tourists towards wetland parks of Colombo district. Further it reveals that, destination attraction, accessibility, amenities, ancillary services, available packages and activities are significantly influence on tourist revisit intention towards wetland parks while destination attraction and the amenities significantly influence on re-visitation of the domestic tourists in a huge manner. Introducing innovative applications and new blogs, launching of new tourist map and promotional social media campaigns directly effect on revisit intention of the domestic tourists towards wetland parks of Sri Lanka.

*Keywords***:** Wetland parks, Destination attributes, Domestic tourists, Revisit intention

Analysis of Tourism Destination Competitiveness in Nuwara Eliya Region (Supplier's Perspective)

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Destination is places where tourism has developed extemporary or has been actively encouraged. A competitive advantage can be achieved if the universal appeal of the destination is valuable to that of optional destination to potential visitors. Destination to become competitive they must strategically promote specific features distinguishing them from similar destinations or establish competitive advantages. According to the Sri Lanka Tourism Development Authority (SLTDA) statistical report 2016, the tourist occupancy rate in high country has been gradually increased. Further Nuwara Eliya and Rathnapura are major tourism destination in high country. Therefore this study selected Nuwara Eliya as a tourism destination. This study mainly focuses on to identify the existing destination attractive determinants, relationship between destination attractive determinants & destination competitiveness and also most significant destination attractive determinant on overall destination competitiveness in Nuwara Eliya region, The study uses model to investigate the destination competitiveness, addressing the following destination attractive determinants : inherited resources, created resources, supporting factors, destination management, and situational conditions. This study is useful to tourism stakeholders and it serve as a guide for other destinations seeking to understand their competitiveness. Research is mostly based on Primary data and researcher used convenience sampling method used to collect data from the 50 tourism industry stakeholders who are in the Nuwara Eliya region. Data were analysed by using SPSS. The results revealed that destination management and situational condition are existing destination attractive determinants , There is a positive relationship between destination attractive determinants and destination competitiveness and also created resources are the most significant destination attractive determinate out of the five determinants.

Keywords: Destination attractive determinants, Tourism industry stakeholders, Destination competitiveness

Challenges and Opportunities for Community Based Tourism Development in Sembuwaththa

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Today tourism industry is a rapidly growing industry in the world as well as in Sri Lanka. Hence, the demand of travelling for experiencing the community based tourism related activities within the world is gradually increasing. The concept of community based tourism is a type of tourism that takes socio, economic and environmental sustainability in to account. In this context, this study specially focuses on identifying the key challenges and opportunities for CBT development in Sembuwaththa tourist destination which is located in Matale, Sri Lanka. Further study also attempts to find out the attitudes and perception of local communities on tourism development in Sembuwaththa tourist destination. In order to achieve these objectives, data were generated through qualitative (in-depth interviews) and quantitative (survey questionnaires) approaches. The researcher has collected data from 10 local community people who are living in Sembuwaththa area and 100 tourists who visited this area according to the convenience sampling method. The quantitative data were analyzed by using descriptive statistics and exploratory factor analysis with the support of SPSS 21.0 version while qualitative data were used to validate the study. In this research several challenges have been identified for CBT development in the study area. Such as lack of knowledge and interest of local community towards CBT, language barriers of local community and lack of infrastructure facilities were identified as challenges. However, number of opportunities like the strategic location site, tourists has high satisfaction level and revisit intention towards the destination after they visited the site, high demand for recreational activities and positive attitude of the CBT participants towards CBT were identified as opportunities for CBT development in the area. This article proposes strategies to develop the tourism industry in the destination with the community participation in sustainable manner.

Keywords: Community based tourism; Community based tourism development, CBT challenges and opportunities

Identifying Potentials to Promote Kalawewa as a Tourist Destination

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Sri Lanka is a country rich with natural, cultural and historical attractions while some of the destinations are not much popular among tourists visiting Sri Lanka. Kalawewa is an area rich with different tourist attractions like Kalawewa reservoir, Aukana Buddha statue, Kalawewa national park, Vijithapura and Reswehera ancient temples. According to previous literature it has defined that this area has numerous resources and it only utilized small fraction of total by the tourism industry. This study aimed at identifying potentials to promote Kalawewa area as a tourist destination and the objectives of the study are identifying the current tourism situation, identifying potentials and developing potentials to promote and increase the retention period of tourists. Data for the study were collected using semi structured questionnaires distributed among sample of 100 tourists who visited Kalawewa and 100 community people live in the area using convenience sampling method. The main analytical technique of the study was exploratory factor analysis. If Kalawewa area is promoted as a main destination for tourists, the main influential factor of the tourists is preferred activities and ancillary services and in community most influential factor is financial support and tourism education. This study recommended to develop infrastructure facilities, ancillary services, provide financial support and other related facilities, provide more knowledge and awareness about tourism industry with the support of public and private parties and build good private and public partnerships among the organizations and also by increasing the awareness using different kind of marketing materials and the use of advanced technology will increase the number of tourists' arrivals and retention period of tourists. Finally this study has identified the potential factors to promote Kalawewa area as a tourist destination.

Keywords: Kalawewa, Destination development, Tourist attraction

Study the Impacts of Destination Attributes to Promote Madhu Church as a Religious Tourism Destination

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Tourism is a vital contributor to the economy of any nation, with it being a prime foreign income earner. The three decades war ended in May 2009 in Sri Lanka and it was a remarkable point in the development of the tourism industry in the Northern and Eastern parts of the country. Madhu Church is a place of devotion and rituals visited by Catholics, Hindus and Buddhists of Sri Lanka. Local and foreign investment is constantly flowing into the sector although religious and cultural tourism is not promoted as a special product of the industry. Hence, the purpose of the study was to identify the impacts of destination attributes to promote Madhu Church as a ritual tourism destination. Primary data collected by the author from 150 respondents including 75 of domestic and foreign tourists using judgmental sampling technique. And also, primary data was collected by using self-administered questionnaire. Quantitative data analytical method was employed in analyzing the data. Data analysis was employed, using descriptive statistics, correlation analysis and multiple regression analysis. Findings of the study revealed that, there is a strong positive relationship between the destination attributes and the promotion potential. And also, barring the available tourism packages, destination attraction, accessibility, amenities and activities done in the region strongly influence the promotion potential level.

Keywords: Destination Attributes, Promotion potential, Tourist satisfaction, Religious tourism

Adoption of IT Practices with Suppliers and its Impact on Operational Performance: E-Business Perspective (With Special Reference to Travel Agencies in Colombo District)

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Across the industries, firms have adopted e-business initiatives to better manage their internal business processes as well as their interfaces with the environment. Development of the technology changed the travel and tourism industry and tourists are moving towards online methods. This creates a competitive environment to the traditional travel agencies. It is important for travel agencies to maintaining a better relationship with suppliers to deliver a quality service to the customers. Hence, the main purpose of this study is to examine and test a moderating effect of supplier relationship quality which integrates the Information Technology (IT) with suppliers (i.e. e-procurement and e-communication) and operational performance in the SME travel agency. Primary data was collected from a sample of 72 SME travel agencies in Colombo district registered under Sri Lanka Tourism Development Authority and random sampling method was adopted. Descriptive analysis, Pearson correlation coefficient and multiple regression analysis techniques were used to analyze data and Adrew Hayes Process Macro was utilized to identify the moderation role of selected variables. Research finding indicated that e-procurement and e-communication have a positive relationship with operational performance. E-procurement significantly and positively influences on operational performance while there is no significant effect found between e-communication and operational performance. Furthermore, supplier relationship quality moderates the effect with the e-procurement and operational performance of SME travel agencies. Results suggested that, even IT adoption of SME travel agencies are in a considerable level, furthermore traditional travel agencies should develop their IT practices with the suppliers and strengthen the relationship quality with suppliers to survive in the travel and tourism industry.

Keywords: IT adoption, e-business, Operational performance, Supplier relationship quality, Small and medium enterprises

Perceived Potentials to Promote Bird Watching in Mannar District, Sri Lanka

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The Gulf of Mannar has biodiversity-rich ecosystem to attract nature loving tourists to Sri Lanka. Bird watching is one of the favorite activities in the tour packages of nature loving tourists even though, bird-watching in Sri Lanka is an untapped niche tourism. Sri Lanka has a great potential for bird watching tourism. Mannar is one of the bird watching tourism markets. Recently, close attention has been taken by bird watching tourism as an environmental friendly way of generating income for the local Community. By identifying the empirical gap, this study focused to identify the tourists' profile while observing the prevailing nature of bird watching and to identifying the potentials to promote bird watching in Mannar district. The data was collected through a questionnaire with a sample of 100 tourists visited Mannar district employing convenience sampling method and semi structured interviews were conducted with 20 government bodies, service providers and residence of bird watching area. The mixed method was employed to analyse the data. The findings of the study shows that, the most of the bird watchers who were male are educated and high income earners. The majority of them are around 40 - 49 age group, travelling with the purpose of bird watching than the other purposes. Further, Mannar having a rich potentiality for promoting bird watching because of the availability of variety of birds and bird watching areas, knowledgeable guides, accessibility and infrastructure, good weather condition and bird watching information source etc. Moreover, government and other responsible bodies should focus on bird watching in tourism planning and development in the destinations.

Keywords: Bird watching, Nature loving, Potentials, Promotion

Empirical Study on Impact of Residents 'Characteristics on Tourism Development (With Special Reference to Mahiyanganaya)

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Tourism is a one of the fastest growing industry in the world. Tourism development has been identified as a key performance indicator in tourism industry. The support of the residents' is very much important for the tourism development. Therefore this study focused on the evaluation of the relationship between residents' characteristics and tourism development with special reference to the Mahiyanganaya. This study focus to identify the existing residents' characteristics and tourism development in Uva province, to identify the relationship between residents' characteristics and tourism development and to recognize most significant characteristic that influence on tourism development in Uva province. The study investigated four major dimensions of resident characteristics in general (residents' experience, length of residency, active engagement and knowledge about tourism). A sample of 150 residents was drawn using convenience sampling technique who are engaging tourism related activities in Mahiyanganaya. Primary data was collected by using self-administrated questionnaire. Data was analysed with SPSS version. Besides, the data were analysed by using descriptive statistics, correlation coefficient analysis and multiple regression analysis to achieve the objectives of the study. Findings of the study revealed that there is a positive relationship with residents' characteristics and tourism development. Further, active engagement and knowledge about tourism are significantly influence on tourism development while length of residency and residents' experience are not significantly influence. Respondents were moderately satisfied with the existing level of characteristics; length of residency and resident experience.

Keywords: Residents' characteristics, Resident support, Tourism development

Visitors' Satisfaction on Sustainable Tourism Practices in Beach Tourism; With Special Reference to Nilaveli Beach

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Beach tourism is one of the most popular areas for outdoor recreation activities. It has grown significantly and generates numerous environmental, socio-cultural and economic impacts. Nilaveli is one of the long sandy beaches in Eastern Coasts. However, the "Sustainability" is one of the key concepts growing all over the world. However, various stakeholders have taken number of initiatives to enhance the quality of visitor experience in the destinations. Therefore this contemporary study was to determine the existing sustainable tourism practices in Nilaveli Beach area, to analyse the tourist satisfaction on such practices and to develop a sustainable tourism model for beach tourism. For this study, the primary data was collected through structured interview from 15 sample units to identify the existing sustainable tourism practices and structured questionnaire from 200 inbound tourists in Nilaveli Beach to identify the visitors' satisfaction. Tourist's satisfaction level was identified in terms of environmentally, socio-culturally and economically sustainable tourism practices. Thematic analysis and Descriptive statistical analysis was used to achieve the research objectives. Study finds majority of the visitors are satisfied on socio-culturally and economically sustainable tourism practices. Most of the visitors satisfied on economically sustainable tourism practices. Consequently the study shows that environmentally sustainable tourism practices are not sufficiently available and it should be further improved in Nilaveli Beach specially it's good to concern marine environment and the beach cleanliness. Sign boards should be replace with the marine environment conscious information, diving instructors and boat operators should take care about corals and marine environment.

Keywords: Beach tourism, Sustainable tourism, Visitors satisfaction

Role of Stakeholders in Promoting Pro-Poor Tourism in Uva Province

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Tourism is given a great significance in most of the developing countries around the world as a tool driven for the economic development. Although the poverty reduction is not usually at the core intentions of the tourism agenda, yet tourism is a significant piece in many poor countries and is already affecting the livelihoods of millions of poor people, positively and negatively. Hence, the pro-poor tourism (PPT) is a globally growing concept intended to reduce poverty by increasing net benefits for the poor from core tourism activities in the rural economies ensuring the core elements of sustainability. Badulla District being one of the poorest in the country rich with numerous tourism resources, PPT can be used as a magnetic solution in developing rural economy. Purpose of this study was to identify the role of different stakeholders in developing PPT in the Uva Province. A sample of 20 was selected using convenient sampling technique including 02 academics, 03 government officers representing the provincial tourism, 08 community members and 03 school teachers from Mahiyanganaya, Ella, and Lunugala DS divisions, and 04 tourists from Ella in the study. The semi structured interview method was used to collect primary data. Results from the thematic analysis reviewed that the access for poor to the market is not sufficient in the current tourism hierarchy. Further, the need for a broader policy framework was highlighted with a participatory approach. Awareness on tourism industry and its benefits to the grass root level, necessary actions to fill the skills gap to develop enterprises and local capacity, managing costs and expectations, maximizing collaboration across stakeholders, and participation in decision making were significant highlights by all levels of stakeholders. The pro-poor tourism initiatives will be a successful key to unlock opportunities for the poor –for economic and financial gains, as well as other livelihood benefits.

Keywords: Pro-poor, Tourism, Stakeholder, Sustainable

Does Begging Add Flavour to Tourism Destinations in Sri Lanka?

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Begging has been identified as a major types of tourist harassment in many destinations in the world. And also, it is considered as a survival activity conducted by people who lack with other categories of income generating activities. Hence, various forms of begging exit in many tourism destinations treating it as a profitable profession from the beggars' perspective and as a harassment from tourists' perspective. As a popular tourist destination, currently, Sri Lanka faces this uncontrollable social and economic problem. Therefore, this study focus to identify the begging types and to analyze the tourists' perspective on begging types exist in tourism destinations in Sri Lanka. The research area for the study was south coastal belt due to high number of tourist arrival and the many tourist harassment reported from the area. Tourists visiting south coastal belt being the research population, the sample was 200 tourists which were selected through stratified sampling technique. Primary data was collected through interviews and observations and data was analyzed using qualitative method. The results revealed that the most exist begging types were disabled, children, adult, busker and performance etc. Many respondents of the study agreed that begging forms like performance, vending and busker etc., represents the local culture and tradition by adding a flavor to the destination. Therefore, future research should be focused on quality enhancement of positive begging forms and reducing negative images traditionally associated with begging.

Keywords: Begging, Destination, Tourists

An Analysis of Foreign Passenger Satisfaction on the Service Quality at Bandaranaike International Airport

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This study aims to investigate foreign passenger satisfaction on the service quality at Bandaranaike international airport. BIA is the major international airport in Sri Lanka. Passenger satisfaction arises when a company can provide benefits that exceed passenger's expectation. Sleeping airport website has ranked BIA as 10th worst airport in Asia. BIA was ranked 25th out of 37 Asian airport surveyed. A study done by Air Transport Research Society on productivity has identified BIA as a low efficient airport in the Asian region. The sample size is 200 foreign passengers among 1.5million annual population. Convenience sampling is selected as sampling technique and self-administered questionnaires are used to collect data. Correlation analysis is used to identify the existing level of the service quality and the passenger satisfaction at BIA. In order to identify the impact of the service quality on the passenger satisfaction at BIA, researcher utilized simple linear regression analysis and used multiple linear regression analysis to identify the service quality determinants mostly influence for passenger satisfaction. Hypothesis developments are accepted and show the significant positive relationship between independent and dependent variables. The demographic profile of foreign passengers expose strong facts of Sri Lankan tourism industry and its potential to growth by identifying the prospectus target market. When consider existing situation of foreign passenger satisfaction at BIA, foreign passengers are almost agree with the passenger satisfaction. Tangibility, responsiveness, assurance and empathy have good impact to airport service satisfaction. According to the findings of the study, passenger satisfaction should improve through physical facilities and reliability of service providers.

Keywords: Airport, Service quality, Satisfaction, Foreign passengers, BIA

Assessing the Impact of Marketing Mix Factors to the Development of Gem Tourism in Sri Lanka

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Tourism industry is rapidly growing industry in the world. Also with the global completion of the world, most of countries are considering different tourism sectors. As a result of that niche tourism concept become a most important aspect of tourism industry. In this study focused on gem tourism. It is one of the untapped niche tourism segments in the world. Sri Lanka is country which has a great potential for gem tourism with its resources. In this respect, this study attempted to explore gem tourism develop within a Sri Lanka with special reference to Rathnapura, Colombo and Kandy. Since, marketing mix factors are critical in any form of tourism to develop, the main purpose of this study to identify the impact of the marketing mix factors to develop gem tourism in Sri Lanka .After the extensive literature review, a conceptual framework has been developed based on the 7 P's in marketing mix. In this study quantitative method used to assessing the marketing mix factors to develop gem tourism from gem tourist's perspectives and questionnaire based survey used to collect data with the convenience sampling techniques. Also qualitative method used to identify the opportunities and barriers from service provider's perspectives and structured interview used to collect data. Initially, descriptive analysis was carried out to screen the existing situation of gem tourism. Further, Pearson correlation analysis and the multiple linear regression analysis have been used as analysis techniques. According to the research findings product and place have the strong positive relationship with gem tourism development and product is the most significant element. Also according to the thematic analysis, unique and quality gems were the main opportunity and lack of promotion was the main barriers for the gem tourism development. Also have to keep more attention to develop gem tourism from the service providers and need to focus on different promotional techniques.

Keywords: Tourism, Niche tourism Gem tourism, Marketing mix, Seven P's.

Need Analysis of a Context Aware Mobile Tour Guide Application to Uphold Sri Lankan Tourism Industry

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Tour guides are front line employees who are very accountable for the complete impression and satisfaction with the tour services provided by a destination. But with the development with new technology, travel and tourism industry have attempted to adopt various new concepts. Context aware mobile tour guide application is one of the latest concepts that the software developers have come up with. This study was conducted to identify the need of the context aware mobile tour guide application to uphold Sri Lankan tourism industry. The study used thematic analysis method to analyze qualitative data using Microsoft Excel. According to the findings of this study, there were 6 main reasons for rejection of tour guide services and states that there are infirmities of human tour guides in tourists' and tour operators' perspective. Finally this investigates the need of the context aware mobile tour guide application to the industry and present some suggestion and directions to the future research.

Keywords: Infirmities of tour guides, Mobile tour guide, Context aware mobile tour guide application

Environmentally Responsible Behaviour in Ecotourism: Evidence from Eco Tourists in Sri Lanka

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Eco tourism is also one of the fastest growing segments among the tourists in the world. This study presents the empirical findings of a quantitative study which looks at environmentally responsible behaviour of tourists engaged in ecotourism in Sri Lanka. Based on the past researchers, this study carried out through behavioural model in which perceived value, satisfaction and activity involvement with respect to the environmentally responsible behaviour. The objectives of the research are to identify the profile of eco tourist in Sri Lanka, to identify the relationship of perceived value, satisfaction and activity involvement with respect to the environmentally responsible behaviour, to identify the effect of perceived value, satisfaction and activity involvement with respect to the environmentally responsible behaviour. Research data mainly depend on the primary data collected from 100 eco-tourists in Ella and Horton plains eco-tourism destinations. Judgemental sampling technique addressed for the study and data collected through structured questionnaire. In order to achieve the objectives of this research, the researcher conducted descriptive analysis, Pearson correlation analysis, and multiple regression analysis. The results show that environmentally responsible behaviour show during and after the delivery of the travel experience. According to the research perceived value, satisfaction and activity involvement can promote environmentally responsible behaviour of tourists. While perceived value directly affects environmentally responsible behaviour, satisfaction & activity involvement can additionally enhance the environmentally responsible behaviour. Finally, based on the determinants, researcher discussed responsibilities of the tourism service providers & other responsible parties to increase the quality of the experience of eco travellers.

Keywords: Eco-Tourism, Perceived value, Activity involvement, Satisfaction, Environmentally responsible behaviour

Eco Tourism Potentials of Waterfalls in Sri Lanka (With Special Reference to Selected Waterfalls in Badulla District)

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Sri Lanka is home to many scenic waterfalls that have created diversified destinations for tourists both local and foreign. Contemporarily, waterfalls are identified as a growing tourism market as the eco-tourism concept emerging in Sri Lanka. But there is lack of scholarly work carried out on eco-tourism potential of Sri Lankan waterfalls. Thus, this study conducted to investigate the eco-tourism potential of waterfalls in Sri Lanka, particularly selected waterfalls in Badulla district. The objectives of the study were to examine the existing tourism destination attributes in selected waterfalls in Badulla district, to identify eco-tourism potential of them and to ascertain the relationship between eco-tourism potential and destination attributes. Data were collected with the aid of questionnaires from a sample of 150 tourists consist with 75 local and 75 foreign with the use of convenience sampling technique. 05 waterfalls were selected for the study namely, Dunhinda falls, Diyaluma Falls, Bambarakanda Falls, Ravana Falls and Bomuru Falls based on judgmental sampling. The descriptive statistics and Karl Pearson's correlation coefficient was used for the data analysis. Multiple linear equation was constructed with respect to study the variables that come under the 5A's concept which consist of Attraction, Accessibility, Activities, Accommodation and Amenities. The study concluded that, eco-tourism potentials of waterfalls in Badulla district have significant relationship with accommodation, amenities, attraction and activities. The study recommended to develop more tourism activities, accommodation facilities and amnesties to attract more tourists to waterfalls for eco-tourism.

Keywords: Waterfalls, Eco tourism, Destination attributes

A Study of the Impact of Visitor Facilities on Visitors' Satisfaction in Pinnawala Open Air Zoological Garden (Special Reference to Domestic Visitors)

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Tourism has grown as one of the largest industries and sources of income generation in recent years among the countries in Asia. Sri Lanka has proved to be one of the fastest growing tourist destinations. Pinnawala Open Zoo is a zoological garden which is situated closer to the Pinnawala Elephant Orphanage and is the first open air zoo in Sri Lanka. Tourism scholars have concentrated on visitor satisfaction as an antecedent of the facilities available in the zoological garden (Snijder, 2013). According to sustainable development target of 2020, zoo should be as self-sustainable organization and it ensures the income of the zoo increased through increment of visitor popularity. Hence, the purpose of the study was to identify the existing level of visitors' satisfaction on visitor facilities, to identify the relationship between visitor facilities and visitor's satisfaction and to investigate the significant factors impact on visitor satisfaction in Pinnawala zoological garden. The primary data was collected by the author from 150 domestic tourists using convenience sampling technique and tested 12 hypotheses. Quantitative data analytical method was employed in analyzing the data using descriptive statistics, correlation coefficient and multiple linear regression analysis. The finding reflects that there is a strong positive relationship with visitor facilities on visitor satisfaction of the domestic tourists of zoological garden.

Keyword: Destination, Visitor facilities, Domestics, Visitor satisfaction, Zoo logical garden

Factors Influencing on Intention to Selections of Sustainable Tourism Destination: Empirical Evidence from Young Local Tourists Visits Anuradhapura

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Tourism is a significant sector for the development of any country's economy. The understanding of visitor's behaviours, such as motivation and attitudinal factors, are necessary for the preparation of tourist destination products. It is important for tourism destinations such as Anuradhapura to attract more visitors. According to SLTDA report data in 2017 review that no visitors visited to Anuradhapura compared with Kandy and less than the Polonnaruwa and Dambulla. Tourists travel for various motives and it is important to identify the factors that may further enhance their attractiveness to tourist destinations. Therefore, the objective of this study is to identifying the factors influencing on intention to select Anuradhapura as a sustainable tourism destination. The population of this study was young local tourists who had visited Anuradapura. Data were collected from two hundred young local tourists through a convenience sampling method, using structured questionnaire and analysed by using SPSS. Researchers developed a model through literature review containing environment attitude, motivation, destination image, word of mouth and perceived service quality. Result shows that environmental attitude, motivation, WOM and perceived service quality are significant and positively influenced to the tourists' intention to select sustainable tourism destination. Tourism related organizations need to concern about above significant factors and giving special attention on perceived service quality and motivation factors due to higher coefficient was reported. This research contributes to extending knowledge in sustainable tourism destination in the context of emerging markets. By fully understanding the relationship between future behavioural intention and visitors while taking into consideration the determinants of behavioural intention, destination tourism managers would better know how to develop an attractive image that improves and sustains tourist patronage.

Keywords: Tourist intention, Tourist destination, Sustainable, Local tourists

Impact of Social Media on Young Local Leisure Travellers' Behaviour: Empirical Evidences from Tourist Destinations in Kandy District

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Sri Lanka has been one of the most prominent tourist destinations for travelers. Leisure travel can be defined as interest of entertaining, and relaxing from everyday life. Most of the time, leisure travel based on social media. Travel behavior represent the way in which tourists behave according to their attitudes during the traveling process. Sri Lanka Tourism Development Authority highlighted that local travelers visited in Kandy get low amount compared to other cities in 2017. Objective of this research article is to investigate effect of social media on young local leisure travel behavior of Kandy. The population representing the number of young local leisure travelers visited in Kandy. Among them, two hundred sample was selected under convenience sampling method. The questionnaire consists of demographic factors and other questions represent all variables and it measured by using Likert scale to measure the impact on young local leisure travel behavior. Significant level of variables were measured by using AMOS software and path analysis. The research identifies independent variables as frequency of travel, destination selection, social sharing and itinerary planning and the dependent variable as travel behavior. H1, H2, H5 and H7 hypothesis were significant. Destination selection and frequency of travel can be identified as intermediate variables and the significant path represent that the travel frequency has a strong influence on travel behavior and destination selection has a significant path to the frequency of travel. Social sharing positively influence the destination selection and destination selection has significant path to itinerary planning and this path was affected on the leisure travel behavior. Therefore, the study gives a positive contribution to travel organizations to increase their travel frequency. The result of the study explains that social media has a strong impact on the young local leisure travel behavior of Kandy.

Keywords: Social media, Young local leisure travelers' behaviour, Kandy tourist destination

An Impact of Motivation on Destination Loyalty of Young Local Tourists: Empirical Evidence from Anuradhapura Tourist Destination

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Tourism has become a fastest growing sector of the world's economy in recent years. It is one of the fastest growing economic sectors of Sri Lanka. Considering Anuradhapura tourist destination, most of the visitors are foreign and elderly tourists. The attractions of young local tourists were poor, but there is a trend among these young local tourists in revisiting Anuradhapura. However, there seems to have a problem with attracting young local tourists and their revisits. So, it is important to identify motivation factors that attract local young tourists to Anuradhapura. Therefore, the objective of this study is to determine the influence of push, pull motivations on tourist's destination loyalty. The target populations for this study are the young local visitors aged between "15–35". The sample was selected through convenience sampling. A structured questionnaire was used to collect data from 200 local young tourists. The questionnaire contains push, pull factors and five - point Licked scale is employed to assess variables. Regression model was used to analyze the data. Independent variables were categorised as push, push motivation factors. Exciting, relaxation, knowledge, education and family togetherness identified as push factors. Availability of modern atmosphere, wide space and activities, suitable weather, historical and religious background, were identified under pull factors. Result shows that excitement, wide space and activities, suitable weather, historical and religious background are statistically significant at 10% level, has positive effect on destination loyalty. Therefore, it is important to improve those significant factors to attract more tourists and promote destination loyalty. This study is useful for the various tourism related organizations to identify the significant factors to take success decisions that affect for increase destination loyalty of local young tourists.

Keywords: Motivation, Destination loyalty, Young local tourists

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