



National Symposium on
Agriculture & Life Sciences

NSALS '24

**" SHAPING THE FUTURE WITH RESEARCH
AND INNOVATION "**

PROCEEDINGS

05th Jan 2024



Faculty of Animal Science and Export Agriculture
Uva Wellassa University



Undergraduate Research Symposium – FASEA, UWU

NSALS '24

National Symposium on Agriculture & Life Sciences - 2024

"Shaping the Future with Research and Innovation"

January 05, 2024

Faculty of Animal Science and Export Agriculture
Uva Wellassa University
Badulla
Sri Lanka

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05th January 2024 @ Uva Wellassa University, Badulla, Sri Lanka

Acknowledgments

The "National Symposium on Agriculture and Life Sciences (NSALS '24)" themed “Shaping the Future with Research and Innovation” is the inaugural undergraduate research symposium organized by the Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka. This symposium would not have materialized without the help, contribution, dedication, and well-wishes of several personalities. The Organizing Committee of NSALS '24 expresses their heartfelt gratitude to the Chief Guest, Professor K.B. Wijesekara, Vice Chancellor of Uva Wellassa University of Sri Lanka, the Keynote Speaker; Professor Ragika Halwathura, Department of Civil Engineering, University of Moratuwa, and the Guest of Honour, Mr. Anurudda Gamage, General Manager/Head HR & Cooperate Sustainability, Kelani Valley Plantations PLC, Sri Lanka for sharing their invaluable experiences and thoughts with us. We would like to thank our colleagues, Dr. A.N.R. Weerawansa and Dr. G.G.N. Thushari from the Faculty of Animal Science and Export Agriculture for sharing their wonderful thoughts at the closing session.

All session chairs, panel members, and track coordinators and conveners deserve special thanks for their valuable contributions to this event. Furthermore, the authors and presenters are deserving of endless praise for their contributions and for sharing their important research findings in a variety of methods. This work would not have been witnessed by the audience without the ready assistance and cooperation extended by the Editor-in-Chief, the members of the Editorial Board, and the Reviewers in finalizing the Proceedings while maintaining the accepted standards in scientific publications. The leaders and members of working committees are also remembered with gratitude as without their kind support, this event would have not been materialised. Special thanks and appreciation are also extended to the IT and Audio-Visual Units of Uva Wellassa University of Sri Lanka for their untiring efforts to stream the event live allowing uninterrupted online conferencing.

A heartfelt appreciation must be extended to Bartleet (Pvt) Ltd as the main sponsor of this inaugural symposium. We are truly grateful towards CIC Agribusiness (Pvt) Ltd., CIC Crop Guard (Pvt) Ltd., and Agrofarm Lanka (Pvt) Ltd. for their financial contribution. Further, the financial support from DFCC Bank, Jiffy Products SL (Pvt) Ltd, Janashakthi Insurance, Badulla, Harishchandra Mills, Browns (Pvt) Ltd, Randika Aquarium Farmhouse (Pvt) Ltd, Lipton Teas and Infusions Ceylon (Pvt) Ltd, RCS2 Technologies (Pvt) Ltd, Seylan Bank-Badulla, and AHEAD DP Project of Department of Animal Science is recalled with gratitude. Finally, sincere appreciation goes to all the committed academic, administrative, and non-academic staff members of Uva Wellassa University of Sri Lanka and all those who actively engaged in the success of NSALS '24.



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NSALS '24

Uva Wellassa University (UWU) stands as a pioneering institution that has reshaped the educational landscape, emerging as a guiding light in the evolution of the concept of an Entrepreneurial and Technopreneurial University within the nation. UWU's educational philosophy is dynamic and prosperous, serving as a driving force that moulds individuals into graduates equipped with knowledge and a priceless array of skills and values. These graduates are not merely employable; they are poised to assume technocratic roles and embark on entrepreneurial journeys, actively contributing to the growth and advancement of the entire nation.

As the "Center of Excellence for Value Addition" to the national resource pool, UWU has been steadfast in its research endeavours since its inception. Within this exceptional academic milieu, the Faculty of Animal Science and Export Agriculture (FASEA) proudly introduces a groundbreaking event: the inaugural "National Symposium on Agriculture and Life Sciences (NSALS'24), the Undergraduate Research Symposium of the FASEA-UWU." The excitement surrounding this symposium is palpable, as it promises to serve as a convergence point for brilliant minds from academia, researchers, scientists, industry experts, and enthusiastic students.

Under the overarching theme of "Shaping the Future with Research and Innovation", NSALS '24 is poised to kindle in-depth discussions, foster collaborative endeavours, and spark fresh ideas that will resonate far beyond its immediate confines. This event signifies an exciting opportunity and underscores UWU's unwavering dedication to advancing knowledge, nurturing innovation, and crafting a future with brilliance and boundless promise. The conference encompasses eight tracks as follows, each focusing on specific areas of interest and expertise.

1. Agricultural Economics, Agribusiness Management, Extension and Entrepreneurship
2. Agricultural Engineering and Process Technology
3. Agricultural Microbiology and Biotechnology
4. Animal Production and Technology
5. Aquatic Sciences
6. Crop Production Technology
7. Environmental Science and Climate Change
8. Food Science and Technology

Following a comprehensive peer-review process, undergraduate students will present 100 selected research papers as oral presentations under the eight theme areas. The abstracts presented at NSALS '24 are archived in a hybrid form of the symposium. This event stands as a testament to UWU's commitment to fostering cutting-edge research and innovation in the field of agriculture and life sciences.



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Chief Guest's Message



It is with immense pleasure that I extend this message on the inaugural symposium, the "National Symposium on Agriculture and Life Sciences (NSALS'24)", an Undergraduate Research Symposium organized by the Faculty of Animal Science and Export Agriculture at Uva Wellassa University. This significant event revolves around the theme of "Shaping the Future with Research and Innovation".

NSALS '24 is a unique hybrid symposium that encourages physical attendance for undergraduate researchers, providing a platform for them to showcase their novel findings. The symposium serves as a space for researchers to present their work to a diverse audience, offering different perspectives and interesting insights. Participants have the invaluable opportunity to witness their research in the fields of Agriculture and Life Sciences and engage with experts in these domains. Moreover, NSALS '24 facilitates individual platforms for participants, including researchers, and scholars to identify potential opportunities and gaps in development, fostering discussions on how to bridge them.

I extend my sincere gratitude to the Organizing Committee and all members of the Faculty of Animal Science and Export Agriculture for their tireless efforts in ensuring the success of the NSALS '24 inaugural symposium. Their dedication has been instrumental in creating a vibrant and enriching environment for all participants.

I wish all presenters and evaluation panellists, pleasant and productive experience during the NSALS'24 symposium. May your contributions and insights further enrich the academic discourse and inspire future research endeavours.

Professor K.B. Wijesekara

Vice Chancellor

Uva Wellassa University of Sri Lanka



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Dean's Message



It is with great pleasure and pride I am forwarding this message for the occasion of the maiden research symposium, "National Symposium on Agriculture and Life Sciences (NSALS '24)", which is held under the theme of 'Shaping the future with research and innovation' by the Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka. The Faculty intends to conduct this symposium every year commencing from 2024 and accordingly, NSALS '24 provides a platform for the budding researchers to present their research findings and obtain experience prior to grooming as intellectuals. Not limiting to Uva Wellassa University, NSALS '24 has provided opportunities for the undergraduates of other universities as well being in the scope of Agriculture and Life Sciences.

Therefore, we believe that we have made a national level platform for taking undergraduates of the country to share their recent scientific findings among each other. Representing Faculty of Animal Science and Export Agriculture, undergraduates of BScHons (Animal Production and Food Technology), BScHons (Export Agriculture), BScHons (Tea Technology and Value Addition), BScHons (Palm & Latex Technology and Value Addition), and BScHons (Aquatic Resources Technology) present their findings in this symposium. The symposium has focused on main eight tracks namely: Agricultural Economics, Agribusiness Management, Extension and Entrepreneurship, Agricultural Engineering and Process Technology, Agricultural Microbiology and Biotechnology, Animal Production and Technology, Aquatic Sciences, Crop Production Technology, Environmental Science and Climate Change, and Food Science and Technology covering main disciplines of the scope.

Since the inception, Uva Wellassa University takes the responsibility of producing graduates who could make a significant contribution to the national economy through value addition to national resource base. Thus, the university provides entrepreneurial education together with other core subjects for all undergraduates in their respective curricula. Further, an effort is made to deliver knowledge and skills requested by the employers of the industry in addition to providing environment for developing attitudes. I believe that providing opportunities for our undergraduates to communicate their research findings related to research and innovation in NSALS '24 will be a great investment for the future. My belief is that NSALS '24 will undoubtedly provide an opportunity to enhance the research culture within the faculty and beyond. Hence, I take this opportunity to appreciate all organizers and the presenters of NSALS '24 for their commitment extended to succeed the event.

Professor H.M.S.K. Herath

Dean, Faculty of Animal Science and Export Agriculture
Uva Wellassa University of Sri Lanka



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NSALS '24 Coordinator's Message



It is my great pleasure and honour to write this message for the inaugural National Symposium of Agriculture and Life Sciences (NSALS '24), the Undergraduate Research Symposium of the Faculty of Animal Science and Export Agriculture (FASEA), Uva Wellassa University (UWU) as the Symposium Coordinator. The idea was conceived in our mind about one year ago when we saw seeds and today I am so happy that we are reaping the harvest.

As UWU is located in Badulla, a remote corner of our island nation, undergraduate students get limited opportunities to present and showcase their research findings. Additionally, the only research conference of the university (IRCUWU) is in June/July annually and our faculty students usually complete their undergraduate research projects in August/September challenging them to present their valuable findings. These are the two main obstacles students of FASEA face where NSALS '24 aims to provide solutions. Apart from that, we also invited all National Universities and Research Institutes to present their undergraduate research projects at NSALS '24. This symposium will be hosted in the hybrid mode with the theme “Shaping the future with research and innovation” intending to uncover new avenues for combating current economic/social challenges through research innovation and new product development which is the only way forward for elevating our country from the third world developing status into a developed nation.

The efforts and dedication of all the members of the organizing, technical, and editorial committees during the organization of this conference are highly appreciated. Indeed, NSALS '24 provides a shared forum for researchers, scholars, and professionals from various disciplines to share their discoveries, information, and perspectives. Through creative approaches and the formation of collaborations, they could create stimulating environments for further investigation and invention. We expect NSALS '24 will be such a platform that advocates for the advancement of all fields related to Agriculture, and Life Sciences. We are excited about presenting 100 research papers under eight thematic areas where a wide variety of ideas will be unfolded. We would like to congratulate all undergraduates from UWU and other national universities/institutes who have achieved this remarkable milestone in their careers for the very first time. We wish an insightful and productive experience for all in-person and online attendees.

Dr. M.K. Meegahakumbura

Coordinator/NSALS '24

Faculty of Animal Science and Export Agriculture

Uva Wellassa University of Sri Lanka



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NSALS' 24 Secretary's Message



It is with great pleasure that I extend my warmest greeting to you all for the National Symposium on Agriculture and Life Sciences (NSALS '24). As the Secretary, I am delighted to witness the convergence of intellect, ideas, and innovation at this Inaugural undergraduate research symposium organized by the Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka.

NSALS '24 promises to be an enriching experience, bringing together experts, scholars, and enthusiasts in the fields of Agriculture and Life Sciences. This symposium will revolve around the theme "Shaping the Future with Research and Innovation" to establish a platform for local academics, researchers, scientists, industry professionals, and students to converge and exchange ideas. Our program is meticulously designed to offer a diverse range of presentations, discussions, and interactive sessions that will foster collaboration and knowledge exchange. I encourage each participant to actively engage in the sessions, share insights, and take full advantage of the networking opportunities. Together, we can contribute to the advancement of research studies and explore new horizons in research.

My heartfelt gratitude goes to the Vice Chancellor, and Dean and all the academic and non-academic staff of the Faculty of Animal Science and Export Agriculture. Your tireless efforts have played a pivotal role in shaping NSALS '24. I also extend my appreciation to the sponsors whose financial support has been crucial, as well as to all the presenters and organizers who have dedicated their time and energy to make NSALS '24 a reality.

I wish everyone a rewarding and intellectually stimulating experience at NSALS '24. May this symposium be a source of inspiration and a platform for the exchange of groundbreaking ideas. Thank you for being part of NSALS '24, and I look forward to the collective success and enlightenment that this symposium will undoubtedly bring.

Ms. A.P. Abeygunawardana

Secretary/NSALS '24

Faculty of Animal Science and Export Agriculture

Uva Wellassa University of Sri Lanka



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Keynote Speech

“Inventions/Innovations Towards Sustainability”



In the past, sustainable living was practiced earnestly, promoting minimalist lifestyles, eco-friendly building materials, wholesome food choices, sustainable transportation, and environmentally conscious household items. This approach aimed to minimize environmental impact while enhancing individual well-being. In Sri Lanka, our ancestors led fulfilling lives, prioritizing health and nurturing harmonious connections with nature. They held dear a deep-seated respect for health and fostered intimate bonds with the natural world around them. However, the advent of new technological advancements led to a gradual erosion of these noble practices over time.

Anyhow, there is a haunting reminder of the potential consequences of unrestrained technological advancement. In our current global landscape, there's a notable shift ; a resurgence towards embracing ancient wisdom and sustainable principles from the past, integrating them thoughtfully into our modern framework. This renewed focus marks a collective effort to steer away from destructive paths and toward a future that respects our planet and its resources.

However, as innovation shapes contemporary practices, there's a renewed focus on integrating past sustainable concepts into current frameworks. Yet, in today's economic landscape, sustainability has, to some extent, transformed into a marketable commodity. It's no longer solely a fundamental practice but has become a commercialized need, often used as a selling point in various industries. This shift raises pertinent questions about the authenticity and necessity of sustainability in the present world. With its commercialization, there's a concern that the core essence of sustainability; focused on environmental and social responsibility might be overshadowed by profit-driven motives. It's become imperative to discern whether the current emphasis on sustainability genuinely addresses the pressing global environmental and social challenges or if it's merely a superficial marketing strategy.

However, amidst these commercial aspects, there's a growing awareness of the real need for sustainability today. Climate change, resource depletion, and social inequalities underscore the urgency for genuine sustainable practices. Individuals, communities, and businesses are increasingly recognizing the imperative to embrace sustainability not just as a market trend but as an ethical and practical necessity. The call for genuine sustainability goes beyond the surface level and delves into meaningful actions that preserve the planet's resources, enhance societal well-being, and ensure a viable future for generations to come.

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Therefore, while the commercialization of sustainability is prevalent, there's still a tangible need for authentic, impactful sustainable practices to address the complex challenges faced by our world today. Balancing economic considerations with genuine environmental and social responsibility remains crucial for creating a sustainable future. Hence, we are committed to finding solutions for real-world problems either natural or near natural. It's a shared endeavor to forge a path where sustainability and reverence for our environment are at the forefront of our priorities, safeguarding the legacy of generations yet to come.

Professor R.U. Halwathura

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EXTENSION & ENTREPRENEURSHIP**

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Paper ID: NSALS24-002

7Ps Marketing Mix and Customer Readiness to Visit Tea Centers in Low Country Region

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Tea center concept is emerging in the Sri Lankan tea industry as an innovative business model to attract a new set of customers. This study analyzed customer readiness to visit tea centers using 7Ps marketing mix elements. Objectives included examining the product, price, place, promotion, people, process and physical evidence as drivers of customer readiness. Seven hypotheses were formulated to achieve the above objectives. Additionally, the study aimed to identify socio-demographic factors that affect customer readiness and determine preferable product-specific factors for customers. Data were collected from a sample of 120 respondents, including 80 local and 40 foreign respondents in Kithulgala using an interviewer-administered, pre-structured questionnaire. The study employed correlation analysis and a binary logistic regression model in data analysis. The results revealed that 78% of respondents were willing to visit tea centers. The majority of respondents were married males in the 26-35 age group. Among the socio-demographic factors, locality, education, and occupation significantly influenced customer readiness to visit the tea center. The combined effect analysis using ordered logistic regression indicated that price, promotion, people, process, and physical evidence were significantly related to customer readiness, whereas product and place showed no significant relationship. Furthermore, the study identified people as the most influential driver and promotion as the least influential driver of customer readiness. Based on the findings, the study recommends that management should focus on improving the marketing mix elements by applying the right mix to attract and retain customers.

Keywords: 7Ps marketing mix; Binary logistic regression; customer readiness; tea center



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Impact of Remittances on Household Expenditure Patterns: A Gender Perspective from Sri Lanka

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Remittances, which are a significant source of income in many Sri Lankan households, have the potential to reshape spending priorities. This study aimed to understand how remittances affect the allocation of funds within households and whether there is distinct expenditure patterns based on the gender of the household head. In order to find the impact, a working lesser model in the Engel's curve framework was applied. This study used data from the Household Income and Expenditure Survey (HIES) conducted in 2019 by the Department of Census and Statistics of Sri Lanka. The data were analyzed using fractional logit models considering male-headed and female-headed households separately. The results suggest that households with female heads that receive remittances appear to have distinct spending patterns than households with male heads. With the receipt of internal remittances, female household head allocate more on other expenditure whereas male household head allocate less on consumer and durable goods more on other expenditure. When receiving international remittances, female household heads spend more on food expense, whereas male household heads spend more on consumer and durable goods. When comparing internal and international remittances, internal remittances have a stronger impact on the spending patterns of households. The results of this study also imply that resource allocation within the household change substantially with the receipt of remittances and depending on the gender of the household head.

Keywords: Expenditure patterns; fractional logit model; HIES; remittances



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Determinants of Export Performance of Coconut Poonac in Sri Lanka: A Time-Series Analysis

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Sri Lanka is one of the world's leading exporters of coconut products, ranking as the fourth-largest exporter overall. Coconut poonac, a kernel-based product, significantly contributes to export earnings. A strong export performance can lead to improved access to international markets and increased competitiveness in the global economy. However, as the export performance fluctuates, the export performance of the poonac industry in Sri Lanka can be influenced by a variety of factors. Therefore, this study attempts to find the determinants of Sri Lanka's export performance of poonac using time series data extracted from the publications of the Coconut Development Authority and the World Bank. The data were analyzed using Auto Regressive Distributed Lag (ARDL) model. The Augmented Dickey-Fuller (ADF) test was used to identify the stationarity properties of the data. The results indicate that all variables are stationary at level I (0) and the first difference I (1). To test for cointegration relationships, the ARDL bound technique was applied. Subsequently, the Unrestricted Error Correction Model (UECM) approach was used to obtain consistent short-run and long-run estimations within a single equation framework. In the long run, production quantity, price ratio of poonac, and Foreign Direct Investment (FDI) have significant positive effects at 5, 10, and 10%, respectively. The inflation rate has a significant negative impact on the export performance of poonac at 10%. The coefficients of the first lag of FDI and the inflation rate were also found to be negatively significant at 5% and 1% significance levels on the export performance of poonac in the short run as well. If any short-term disequilibrium develops, it will be temporary and will be resolved over time at a rate of 79.8% each year. These results are essential for assisting trade experts and policymakers in creating strategies to increase the country's exports of poonac.

Keywords: ARDL model; export performance; poonac industry; time series data



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The Impact of Pension Receipt on the Expenditure Patterns of Elderly Households in Sri Lanka: A Working Leser Model Approach

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This study investigates the influence of pension receipt on the expenditure patterns of elderly households in Sri Lanka, employing Working Leser Model approach. Secondary data from the Household Income and Expenditure Survey (HIES 2019) conducted by the Department of Census and Statistics were utilized for analysis. The study focuses on 9,421 households with at least one elderly person aged 60 years or above, among which 1,428 households receive pension payments. The findings highlight that pension receipt significantly affects the expenditure patterns of elderly households. Pension receipt is positively associated with increased expenditure on food and consumer goods, indicating improved financial capacity for basic needs. While the significance of pension receipt is somewhat weaker in the fractional logistic regression, its overall positive influence on essential expenses is notable. However, the study did not find a significant impact on education, health, housing, and miscellaneous expenditure shares, suggesting potential areas for further investigation. Furthermore, gender emerges as a crucial factor shaping expenditure patterns within elderly households. Female-headed households tend to allocate a larger proportion of their budget to education, travel, and leisure (other expenses), while male-headed households prioritize food and health expenditures. Households with a higher number of employed individuals tend to allocate a greater portion of their budget towards essential expenses such as food, housing, consumer goods, and leisure transportation. Moreover, demographic and household characteristics, such as age, education level, marital status, and household size, exert significant influence on expenditure patterns. Larger households allocate more resources to education, while higher education levels correlate with increased spending on education-related expenses. The research emphasizes its crucial to recognize the urgency of improving support systems and uplifting the living standards of elderly households in Sri Lanka. These findings provide vital evidence for evidence-based policies aimed at promoting a sustainable and equitable future for Sri Lanka's elderly population.

Keywords: Elderly households; expenditure pattern; fractional logit model; pension receipt; Working Leser model



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Factors Affecting Consumer Preferences Level for Cold Brew Tea Products

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The contemporary Sri Lankan tea industry is at a crossroads, facing the challenge of adopting to consumer preferences for cold brew tea products as the bulk tea export market gradually shifts towards value-added forms. One innovative offering in this evolving market is cold brew tea, introduced by HVA Foods PLC. In light of these changes, businesses operating in the Sri Lankan tea industry must cultivate a deep understanding of the desires and values held by both existing and potential customers, particularly in the realm of cold brew tea offerings. The research aims to study consumer preferences for cold brew tea products. The methodology employed for this investigation utilized conjoint analysis with data collected from 120 individuals randomly selected from the population that had experienced Heladiv cold brew iced tea at hotels and restaurants in the Western and Southern provinces. Data collection involved face-to-face interviews conducted after customers had the opportunity to sample Heladiv cold brew iced teas. The research employed a semi-structured questionnaire, initially pretested with 20 customers and subsequently refined to align with the research objectives. The study underscores the intricate connection between consumer preference of cold brew tea products and specific marketing mix elements. Consumers exhibit a preference for superior product characteristics, showcase sensitivity to pricing, and respond positively to effective promotional efforts. Factors related to product distribution and availability, encapsulated in the "Place" variable, also contribute significantly to higher consumer preferences. Businesses aiming to enhance consumer acceptance are advised to optimize these marketing mix elements. The logistic regression model, evaluated using the Wald test and Pseudo R-Square values, displayed a statistically significant predictive ability, explaining around 20-26% of the variance in customer preferences for cold brew tea products. This suggests a moderate overall explanatory power of the model. Furthermore, ordinal logistic regression was employed to delineate the impact of various factors on customer preferences. An increase in 'Product,' 'Place,' and 'Promotion' variables positively influences preferences, while an increase in the 'Price' variable diminishes preferences. The study concludes by prioritizing the most preferable product attributes: packaging size, brew time, availability, and flavors. By aligning product offerings with these preferences, particularly emphasizing the 2.5g packaging size, 6-minute brew time, Peach flavor, and availability in supermarkets, producers can enhance their product's appeal and competitiveness.

Keywords: Cold brew tea; consumer preferences; conjoint analysis; marketing concepts; Sri Lankan tea industry



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Potentials and Challenges of Developing Plant Tissue Culture as An Agrotourism Product; Farmers' and Visitors' Perspective.

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The agrotourism industry, particularly plant tissue culture-based agrotourism, has emerged as a lucrative niche market segment within the tourism sector. While this concept has gained popularity worldwide, Sri Lanka is yet to conduct formal studies on this concept positively impacting the country's plant tissue culture-based tourism sector. However, the current situation presents an opportunity to revitalize the sector and move it towards a more sustainable future, discussing potentials and challenges more broadly. This study aims to explore ways to develop plant tissue culture-based tourism in Sri Lanka, focusing on the potentials, challenges, and issues faced by the local farming community and the perception of farmers and local visitors. The research employed qualitative approach, collect the data through snowball from 12 farmers and purposive sampling techniques from 8 local visitors in the Uva Province. Content analysis was used to analyze the data. The findings highlighted operational, financial, labor-related, communication, technological, and economic factors influence the development of plant tissue culture as an agrotourism product. The study emphasizes the importance of government and private sector involvement, technological advancements, and long-term and short-term policy planning in promoting plant tissue culture as a tourism product. To mitigate potential challenges and ensure sustainable operations, the study suggests implementing transformational strategies such as government support, financial assistance, promotional activities, and research and development initiatives. By doing so, the sector can attract travelers and establish itself as a niche market segment. The study's results holdsignificance for future generations, policymakers, and academia providing valuable insights for the operation and development of plant tissue culture-based agritourism activities. Overall, this study underscores the need to develop the plant tissue culture-based agrotourism sector in Sri Lanka and offers recommendations for its successful integration into the tourism industry.

Keywords: Agrotourism; plant tissue culture; plant tissue culture-based agrotourism



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Factors Affecting on the Loyalty Engagement of Tea Smallholders on Bought Leaf Supply Base of Tea Smallholder Factories PLC

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The Ceylon tea industry holds a prominent global reputation for its remarkable quality and historical significance. This study delves into the factors affecting loyalty engagement of tea smallholders in low country region based on three pivotal smallholder factories; Neluwa-Medagama, Hingalgoda, and Halvitigala under the aegis of Tea Small Holder Factories PLC, a subsidiary of John Keells Holdings, since the company has identified downward movement in loyalty engagement of smallholders and less interaction towards the factory in last few years. A stratified sampling technique was employed engaging 125 tea smallholder farmers. Data were collected through a questionnaire, encompassing socio-demographic aspects, financial intervention, competitor's intervention, social intervention, effectiveness of extension services knowledge on field activities and price factor. The questionnaire was pretested, and all Cronbach alpha value were >0.7 which indicates proper internal consistency. Descriptive analysis, correlation analysis and multiple linear regression techniques were used to elucidate the relationships between loyalty engagement exhibited by smallholders with independent variables. The incorporation of a Likert scale further categorizes respondents' perceptions, lending depth to the analysis. Correlation analysis indicates weak and non-significant relationships between examined variables and loyalty engagement. Regression reveals that the Index Price Factor and Index Social Intervention of TSFL Extension Service are statistically significant at the 0.05 level. Conversely, experience, smallholder age, competitor interventions, and transportation display negative associations with loyalty engagement. In conclusion, this study unveils insights into factors affecting smallholders' loyalty engagement in the tea industry. Significant variables such as pricing and social interventions impact loyalty positively, while experience, age, competitor interventions, and transportation exhibit negative correlations. These findings offer valuable insights for stakeholders in enhancing smallholder loyalty within the tea industry.

Keywords: Agriculture extension loyalty; engagement; tea smallholders; tea smallholder factories



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Appraisal of the Small-Scale Dairy Farming in Kurunegala District of Sri Lanka

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This study provides insight into the current state of Sri Lanka's dairy farming industry, which has not kept pace with the country's rapid technological advancements, impeding economic growth. The study focused on small-scale dairy farmers selected using the random sampling technique from both dry and wet zones in the Kurunegala district. Primary data were collected through a semi-structured questionnaire and analyzed using descriptive techniques while SWOT analysis was conducted to identify and address the issues faced by these farmers. The study revealed that each farmer produces an average of 12.25 liters of milk per day. Over half of these farmers fall between the ages of 46-60 and are predominantly male indicating a clear lack of youth involvement within the area. Additionally, 59% of the farmers have only studied up to the Ordinary Level, while 95% are literate. Moreover, Jersey crossbreeds comprise 76% of the cattle in the area while a government institute collects 35% of the milk in the study area. A well-organized milk collecting and chilling network, introduction of KPIs for the dairy farmers, availability of coconut cultivations and crop residues, were identified as opportunities for the industry. Possessing high yielding cattle breeds, cattle being an asset during troubled times, and industry creating an extra income are the strengths identified. However, usage of lake grounds as grazing lands during the dry periods leads to lack of feed during wet seasons. Furthermore, the widespread prevalence of lumpy skin disease in the area has a direct impact on milk production. The study identified low levels of higher education, less youth contribution, and less implementation of knowledge gained by extension programs as major weaknesses. Limited access to credit and loans from banks, and poor infrastructure facilities in the study area were identified as primary threats. In addition, the lack of semen artificial insemination and low success rate in artificial insemination are other major threats that farmers must overcome. Addressing these issues and providing farmers with the knowledge, novel techniques, and resources they need to increase productivity will ensure a sustainable future for the dairy sector.

Keywords: Dairy production; descriptive techniques; random sampling; SWOT analysis



Maize Farmers' Willingness to Pay for Seeders: A Case Study of Moneragala District

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Maize is the second most prominent cereal grain in the world, and it is the most important cereal in Sri Lanka after rice. In addition, it is a major ingredient in poultry feed and is also used to make Thriposha, a nutritional supplement for pregnant and breastfeeding mothers, infants, and malnourished children. However, the rising cost of maize production, driven by high labor costs and manual seeding methods, is intensified by the scarcity of agricultural labor. To address these challenges and enhance production, profitability, and cost-efficiency, mechanization is crucial. However, in Sri Lanka, mechanization in maize cultivation is mainly limited to land preparation and threshing, with limited adoption in seeding. Expanding mechanization to all stages of maize cultivation is essential to maximize its benefits and overcome labor and cost-related hurdles. With the high cost of the machinery farmers are not able to purchase their own machinery. The best option is to hire machinery. Therefore, in this study, the willingness to pay (WTP) for adopting seeders through hiring service centers models in the Moneragala district was evaluated. A total of 71 farmers were selected through random sampling technique from the Ethimale and Siyambalanduwa Agrarian Service Areas, utilizing the Contingent Valuation (CV) method. The data were collected by face-to-face interviews and group discussions. Double bounded dichotomous choices with follow-up open-ended questions of CV methods were employed to elicit the WTP for seeder hiring. Both econometrics and descriptive models were used for this analysis. To determine the factors influencing WTP, a Probit model was employed, while a bivariate Probit model was used to estimate the mean WTP. The CV method was conducted using a bidding technique. The initial bid was taken through case studies from maize seeder owners in respective area. The findings from the probit model demonstrate that factors such as age, income, land extent, and family engagement significantly and positively influence farmers' willingness to pay (WTP) for seeders. Interestingly, age and family engagement have negative effects on WTP. Although education and farm gate price do not have a significant influence on WTP, they affect positively. Income has the highest influence on the WTP. Out of the total sample, 71% of the farmers were found willing to pay to rent a seeder. The study estimates the mean WTP for seeders to be Rs. 5,000 per acre. Based on these findings, the study recommends the establishment of hiring centers to facilitate the adoption of seeders by maize farmers in the Moneragala district. Furthermore, fostering private-public partnerships could prove beneficial in assisting small-scale farmers in adopting seeders.

Keywords: Bivariate probit model; contingent valuation; double-bounded elicitation format; probit model; seeders; willingness to pay



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Coconut Industry in Sri Lanka: The Present Status and Future Challenges for Development

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The coconut industry is one of the best income sources in Sri Lanka. While Sri Lanka has favourable conditions for growing coconut, the Sri Lankan coconut industry is facing many challenges, which makes necessary to develop a strategic plan for the coconut industry. Coconut is a multipurpose tree and kernel, fibre, and shell are used in food and non-food sectors. Hence, one of the purposes of this study was to identify the current condition of the coconut industry, and to identify the problems of the coconut industry. Further, analyzing the present status and future challenges is important to coconut cultivators, processors and all the stakeholders. From 1992 to 2022 annual data collected for this study. Analyzing secondary data for 30 years using descriptive statistics including graphs, this study identifies the current trends and patterns in production, cultivation extent, cost of production, rainfall effects, production of value added products, marketing issues, market price of coconut products, export volume of kernel and non-kernel product and export earning of the coconut industry. Accordingly, the coconut industry is a viable income source in Sri Lanka and it needs expand of coconut production. Subsequently, it will facilitate managing the marketing issues and improve the earnings of coconut industry. Further, a SWOT analysis was performed to identify the strengths weaknesses, opportunities and threats related to the production of the coconut based products. Accordingly, the major strengths in the coconut industry were the greater profits for coconut cultivators and higher export earnings of the coconut and coconut-based products. In addition, major weaknesses of the coconut industry were the shortage of raw materials due to the high local consumption of the raw coconut while the industry shows good opportunities to generate employment as it faces major threats such as labour shortage.

Key words: Coconut industry, export earning, nut production, SWOT analysis



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Effect of Precipitated Silica as a Filler to Stabilize the Dimensional Changes of Cured Foam Blocks Made of Natural Rubber

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Natural rubber latex foam is a versatile and widely used material in various industries due to its unique properties such as excellent elasticity, resilience, and durability. Natural rubber latex foams are suitable to manufacture numerous foam products. Occasionally, foam products are reported shrinkage issues when reach customers, despite being manufactured and marketed as high-density foam. This discrepancy causes dimensional changes in foam manufacturers and retailers. This study focused on minimizing dimensional changes and enhancing the physical properties of natural rubber latex foam composites by incorporating precipitated silica filler as a dispersion. Rubber and precipitated silica interactions on the shrinkage of foams were tested. The pH, total solid content (TSC), mechanical stability time (MST), and gelling time were tested as chemical properties. Indentation force deflection (IFD), tensile strength, and elongation at break (%) of foam blocks were tested as physical properties. Silica dispersion was added into compounded latex at 0 (control) to 10 parts per hundred rubbers (phr), at 2 phr intervals. The indentation force deflection of the control and 6 phr samples at 65% of compression were 22.05 and 31.83 N, respectively. The best IFD in the sample series was at 6 phr of precipitated silica. The elongation at break (%) of the control and 6 phr samples were 213.41 and 388.21, respectively. The tensile strength of control, 6 phr and 10 phr samples were 6.18, 12.02 and 14.23 N, respectively. The tensile strength was within the specification in 10, 8 and 6 phr. This study leads to the production of natural rubber latex foam with enhanced physical properties with the incorporation of precipitated silica to avoid dimensional changes at the level of 6 phr. In summary, the findings of this study confirmed that the presence of precipitated silica leads to a reduction in the dimensional changes of the rubber matrix by enhancing physical properties.

Keywords: Crosslink density; dimensional changes; natural rubber latex foam; physical properties; precipitated silica



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Improvement of Indoor Environmental Quality; Combining Vertical Greenery Systems (VGS) with Air-Conditioning in Tropical Environment

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Vertical greenery systems (VGS) are sustainable architectural practices that promote vegetation growth on buildings' exterior or interior walls, reducing heat islands, increasing thermal efficiency, conserving cooling energy, removing pollutants, and improving air quality. VGS can reconnect urban-nature connections and reduce stress levels. The objective of this research study was to compare the performance of air-conditioned rooms with VGS to those without VGS, focusing on their impact on indoor air quality, productivity and the comfort and well-being of individuals in commercial buildings. The study was conducted at the University of Moratuwa, serving as the designated experimental site. Two identical rooms maintained at a controlled 25°C air temperature, Room A without VGS and Room B with VGS, were chosen to study the effectiveness of integrating a VGS with an air conditioning system. Participants spent a particular time in Room A, followed by a few minutes in a designated resting area. Subsequently, participants spent in Room B. After completing the questionnaire, participants were directed to an outdoor area to conclude the study. Purposive sampling techniques were used to ensure a representative sample size of 50 responses for robust analysis and meaningful insights. A paired t-test was conducted using SPSS software to assess the differences between conditions with and without the implementation of a VGS. The analysis focused on various aspects. The results of the paired t-test indicated respondents' perceptions of air quality ($P < 0.05$), visual appearance ($P < 0.05$), their willingness to work continuously in such a setup for more than one hour without breaks ($P < 0.05$), and their overall feelings about the rooms ($P < 0.05$) indicated a statistical difference ($P < 0.05$) in the mean values between Room A and Room B. The survey revealed that 94% of respondents were enthusiastic about incorporating a VGS into their indoor spaces, and 74% were willing to integrate it into their working environments. The study emphasized the significance of indoor environmental quality in office spaces and evaluated the benefits of nature-based elements, highlighting a significant gap in research in tropical climates despite its prevalence in temperate regions.

Keywords: Air condition; indoor air quality; occupant; vertical greenery system



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Effect of Dioctyl Phthalate and Soybean Oil as Plasticizers on the Bonding Strength of PVC Shoe Sole

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Thermoplastic polyvinyl chloride is one of the significant polymers in the shoe industry. Bonding issues, notably related to plasticizers, are a concern in shoe manufacturing. This study explored how the bonding strength of polyvinyl chloride shoe soles is influenced by two different plasticizers: dioctyl phthalate, a common plasticizer in the shoe industry, and soybean oil, a sustainable, biodegradable, non-toxic, and low-volatile, alternative secondary plasticizer. They were compared in their impact on polyvinyl chloride properties, including hardness, specific gravity, abrasion loss, and bonding strength. Thermo-gravimetric analysis quantified the current plasticizer content as 5%. Thirty shoe sole samples were prepared for each plasticizer category using injection moulding technology. The plasticizer dosage was systematically changed in increments of 5, 10, 12.5, 15, 17.5, and 20%. The results of One-way ANOVA showed that the increase in both plasticizer dosages led to a reduction in hardness, specific gravity, and bonding strength. Simultaneously, abrasion loss showed an increasing trend as the plasticizer dosage increased. Therefore, the current 5% plasticizer dosage was preferable over increasing the dosage to maintain optimal bonding strength for polyvinyl chloride shoe soles. For 5% plasticizer dosage, dioctyl phthalate-treated polyvinyl chloride shoe soles exhibited significantly similar bonding strength value (12.68 kg) compared to soybean oil-treated shoe soles (12.88 kg). Due to that, it is suggested that at this plasticizer dosage, dioctyl phthalate can be replaced by soybean oil plasticizer and the drawbacks associated with dioctyl phthalate including potential toxicity and environmental concerns, can be effectively addressed. In addition, coconut sludge oil is suggested as an alternative material in future studies.

Keywords: Bonding strength; dioctyl phthalate; plasticizer; polyvinyl chloride; shoe sole; soya bean oil



Influence of Different Parboiling Process on Milling Yield of *Addakari* Paddy Variety

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The quality of rice can be enhanced by the hydrothermal process called parboiling, which alters the physiochemical characteristics of paddy grains. As milling of raw rice without parboiling induces breakage of grains, the present study was carried out to find the effective parboiling process for the traditional paddy variety *Addakari* to reduce such loss. At first, the paddy was soaked under two conditions namely, cold water soaking at ambient temperature ($27\pm 5^{\circ}\text{C}$) for three different duration (24, 48 and 72 h) and hot water soaking at three different temperatures (40, 50 and 60°C). The soaked paddy underwent three methods of steaming process pressure-soaked steam parboiling (PSS), open-soaked steam parboiling (OSS), and un-soaked steam parboiling (USS). After that, the above samples were allowed for oven drying at 60°C for 3 h. It was followed by milling rough paddy using an analytical grade de-husking machine after which the brown rice was polished to remove the bran to a certain level. Then, the milling recovery, head rice yield (HRY), and broken rice percentage were measured. In all different parboiling processes, the milling recovery ranged from 70.16 to 74.84%. In terms of HRY for the cold-water soaking, soaking of paddy for 24 hours with PSS yielded the highest HRY of 76.81%, whereas paddy soaked for 72 h followed by USS led to the lowest HRY of 63.20%. When considering the hot water soaking, the paddy soaked at 60°C and steamed in PSS gave a maximum HRY of 80.16% while paddy soaked under 40°C continued with USS showed a minimum HRY of 66.32%. In contrast, milling paddy without parboiling showed a poor HRY of 40%. Based on this study, it can be concluded that the parboiling process with hot soaking at 60°C followed by pressure-soaked steam parboiling is suitable to obtain comparatively higher head rice yield which may be due to the development of hardness with increasing temperature. It is suggested to determine the cooking quality and sensory properties in future studies.

Keywords: Hardness; head rice yield; hot water soaking; milled rice yield; pressure-soaked steaming



A Novel Approach for Separation of Dissolved Matters Presence in Waste Generated at the Crepe Rubber Processing Plants Using a Solar-Powered Drum System

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Although wastewater generated during the crepe rubber manufacturing process contains low concentrations of organic and inorganic pollutants, it presents a challenge for cost-effective treatment methods. Current methods used for wastewater treatment are more costly and have low efficacy. Introducing a straightforward system to separate water and pollutants would revolutionize the process, offering economic efficiency, environmental sustainability, and simplified operation, to effectively address industry challenges. This study explored a novel approach for wastewater treatment techniques by concentration of dissolved solids and evaporation mechanism of volatile matters at ambient conditions (28-30°C, > 85% RH, natural air flow). The remaining concentrated pollutants potentially can be used as fertilizer. Using several materials such as cotton, sponge, woven, *goni* fabric, and gunny sack, the wastewater absorbance rate was measured. The evaporation efficiency was high for the gunny sack material at the 0.05 level of significance. To optimize the wastewater treatment process, a gunny sack material-wrapped solar-powered drum system was designed and fabricated. The effluent was collected from the Dartonfield crepe rubber processing factory and key wastewater quality parameters such as chemical oxygen demand (COD), biological oxygen demand (BOD), pH, and total soluble solids (TSS) were checked. With the evaporation process, dissolved solids were concentrated, leading to elevated levels of total dissolved solids (TDS), COD, BOD, and total ammonia nitrogen content (TAN) in the concentrate. The TDS of the condensed water vapors (20 ppm) consistently met the prescribed regulatory environmental standards (< 1000 ppm), indicating efficient removal of the contaminants. In addition, COD and BOD values reached the recommended limit for discharging the treated wastewater. Further, the concentration of the remaining semi-sludge concentrate was 198, 221, and 855 ppm, respectively showing its potential for use as a fertilizer. In conclusion, the development of a solar-powered wastewater system reduced the pollutant levels present in the wastewater and concentrated dissolved organics into a semi-solid yielding a potential source for organic fertilizer.

Keywords: Absorption; evaporation; semi-solid; wastewater; water quality standards



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Effect of Origin and Rolling Method on Physical and Chemical Properties of Black Tea – A Meta-analysis

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Black tea (*Camellia sinensis* L.) is a non- alcoholic, flavoured and therapeutic drink adored by tea lovers worldwide. This tea is more than a simple drink; it is a complex infusion characterized with elements such as polyphenols, amino acids, theaflavins, thearubigins, catechins, and caffeine. This intricate composition of tea encompasses appearance, colour, aroma, and taste, which require meeting the consumer preferences ensuring the product quality and promoting sustainability. A total of 44 studies, exploring the impact of country of origin and rolling method on physicochemical properties, were identified through searches in Web of Science databases and secondary referencing for inclusion. The preferred reporting items for systematic reviews and meta-analyses (PRISMA) method was used in identifying key attributes, assessing changes in chemical composition, and exploring sensory characteristics. The major tea-producing countries such as China, India, Kenya, Sri Lanka, and Turkey were considered for black tea origin and orthodox and Cut, Tear, and Curl (CTC) were considered for rolling methods. Both the origin and rolling method had a significant influence on chemical properties rather than physical properties ($P < 0.05$). The Chinese black tea had the highest caffeine content ($P < 0.05$), while the Indian black tea showed the highest in polyphenol content ($P < 0.05$). The Chinese black tea had a more favourable theaflavin-to-thearubigin ratio, and the Indian black tea appeared as brighter compared to those from China, Sri Lanka, and Kenya. Additionally, Chinese tea exhibited a better liquor colour than Sri Lankan black tea. In the rolling method, the CTC resulted with higher thearubigin values than orthodox rolling ($P < 0.05$). This study concluded that chemical parameters are significantly influenced by the origin and the rolling method of black tea.

Keywords: Black tea; geographical origin; meta-analysis; physicochemical parameters; rolling method



Evaluation of Effluent Quality Parameters of a Modified Coconut Husk Retting Method

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Conventional retting is the most widely accepted method, involving soaking coconut husks in water for generally six months. The separation of the leathery exocarp from the fibrous mesocarp of the husk is the result of retting. It is a very rudimentary industry that has severe impacts on the engaged population and the environment. The water quality of retting pits severely deteriorates due to the buildup of hazardous organic compounds and the formation of anaerobic sulfide in the retting zone. Therefore, an innovative coir retting pit design was made to improve the water quality of the retting pit. In the modified design, the effluent was fed to the husk-filled tank via a sprinkler system and the treated effluent was rotated while washing the coconut husks. In this study, three treatments were used: a new pit with clear water (method-1), a new pit with the microbial consortium (method-2), and a conventional retting pit (control). The experiment was conducted for three months, and water samples were collected every 2 wk to compare the microbial activity and effluent quality parameters such as pH, electrical conductivity, and turbidity of modified methods against the control. One-way Analysis of Variance was employed to test the statistical difference between means. According to the Oxitop test results, the control had a higher microbial activity compared to method-1 and method-2 ($P < 0.05$). Treated effluent of method-2 showed a higher pH value (7.13) than that of method-1 (6.96) and control (6.62) ($P < 0.05$). The electrical conductivity of the conventional pit was significantly higher than those of method-1 (180-2,650 $\mu\text{S}/\text{cm}$) and method-2 (238-506 $\mu\text{S}/\text{cm}$) at each week ranging between 907-3987 $\mu\text{S}/\text{cm}$. The effluent of method-1 had a lower turbidity (148-332 NTU) compared to those of method-2 (177-896 NTU) and control (779-1041 NTU) ($P < 0.05$). Thus, turbidity and electrical conductivity were considerably lower in improved system effluents, indicating a reduction in suspended organic contaminants that might be harmful to the environment. In conclusion, the study revealed that in terms of effluent quality, the modified method-1 approach is a feasible alternative to the conventional method.

Keywords: Aerobic coir retting; effluent quality; microbial activity; recycle; washing



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Hypsometric and Tea Land Use Analysis of Uma Oya Sub-basin of Mahaweli River Basin, Sri Lanka

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Morphometric analysis examines surface characteristics like elevation, slope, aspect, and curvature, while hypsometric analysis uses hypsometric curves to study elevation distribution in a specific area. Land use analysis focuses on evaluating the allocation and utilization of land for various purposes within a given region. This study was aimed to find the relief parameters, develop a hypsometric curve, and check the changes in tea land use over the last two decades (2002 and 2022) in the Uma Oya sub-basin. The study utilized the spatial data extracted from a digital elevation model generated from a 20-m contour layer in ArcGIS 10.8 software. A hypsometric curve was constructed by plotting the cumulative area above specific elevations against corresponding elevation values. Additionally, data on tea land use in the study area were acquired for 2002, 2012, and 2022. Information for 2002 was obtained from topographic map sheets, while data for 2012 and 2022 were collected from prepared digital layers using Google Earth Pro software. The results highlighted significant variations in basin relief among different locations. The highest relief of 2.33 km indicated a rugged, mountainous terrain, while the lowest relief of 0.39 km suggested a flatter landscape. The plotted hypsometric curve and the calculated hypsometric integral value of 0.49 indicated that the watershed was in equilibrium or mature stage of development, signifying a certain degree of stability. From 2002 to 2022, there was a substantial decrease (63%) in tea cultivation and vegetation cover, with a notable reduction from 2002 to 2012 (38%) and from 2012 to 2022 (40%). Finally, it can be concluded that there is a diverse terrain characteristics, mature and equilibrium watershed features, and significant changes in tea land use in the Uma Oya sub-basin, emphasizing the need for sustainable land stabilization plans when certain development activities to be implemented within this hilly area.

Keywords: Digital elevation model; hypsometric curve; tea land use changes; terrain characteristics; watershed features



The Effect of a Biological Treatment Method on the Reduction of Total Dissolved Solids Levels and Chloride in Activated Carbon Washing Effluent

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The activated carbon (AC) washing process effectively removes impurities and contaminants from carbon, resulting in wastewater with elevated levels of total dissolved solids (TDS) and chloride ions (Cl⁻). The generated wastewater becomes contaminated with dissolved and suspended pollutants such as organic waste, ash, dust, and chemicals, making it unsuitable for direct discharge into the environment. This study investigates the remediation potential of three aquatic plant species: *Eichhornia crassipes*, *Pistia stratiotes*, and *Lemna minor*, guided by guidelines set by the Central Environmental Authority, which advocate for TDS < 1000 mg/L and Cl⁻ content < 400 mg/L. Three types of aquatic plants were used to test the effectiveness of the biological treatment method for reducing TDS levels and removing Cl⁻ in the wastewater treatment process over 19 d. Plants were placed in barrels containing 20 L of wastewater, with each treatment having three replicates. Separate controls with only wastewater were established to check the changes in water quality and assess the reduction of key parameters. The study covered a variety of wastewater quality parameters, such as pH (P < 0.05), TDS content (P > 0.05), electrical conductivity (EC) (P < 0.05), and Cl⁻ content. (P > 0.05), which were tested at two-day intervals. It revealed the remarkable efficiency of *E. crassipes* in significantly reducing TDS levels until thirteen days emphasizing their potential to enhance wastewater quality. However, the effectiveness of TDS reduction by *E. crassipes* decreased over time, emphasizing the need for continuous monitoring and plant management. Notably, no differences (P > 0.05) were observed in Cl⁻ levels in the storage period and among plant types. The study also monitored *E. crassipes* plant responses to varying Cl⁻ concentrations and conducted water extraction tests, specifically focusing on Cl⁻ absorption. Morphological tests revealed the sensitivity of *E. crassipes* to elevated Cl⁻ concentrations, as evident through visible stress symptoms like stem decay, leaf withering, and browning. However, water extraction tests underscored the plant's limited ability to absorb Cl⁻ ions, highlighting the necessity of exploring alternative Cl⁻ content reduction techniques. Overall, the study highlights the significant potential of *Eichhornia crassipes* for wastewater quality improvement.

Keywords: Aquatic plants; chloride content; electrical conductivity; total dissolved solids; wastewater



Impact of Varied Zinc Concentration Levels on Natural Rubber Latex Film Properties

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The introduction of zinc oxide (ZnO) into natural rubber latex has the capacity to enhance the concentration of zinc ions (Zn^{2+}) within the latex colloid, leading to the stability of the latex system. However, it is imperative to exercise caution with respect to the quantity of zinc oxide employed, excessive or lower concentrations have been observed to compromise the physicochemical and physico-mechanical properties inherent to natural rubber latex. This study investigated the effect of Zn^{2+} concentration on physicochemical and physico-mechanical properties of natural rubber latex with respect to glove formulation. Five concentrated high ammonia latex samples were treated with varying amounts (180, 240, 300, and 360 ppm) of Zn^{2+} and kept for 21 d of maturation. Mechanical stability time (MST), volatile fatty acid number (VFA), phosphate levels, alkalinity, and pH of the latex were measured according to ISO procedures weekly for 3 wk to analyze the fluctuation in latex properties during storage. After 21 d, samples were compounded, and MST was estimated twice a day for 3 d. Changes in film properties such as tensile strength and tear strength were investigated after preparation of latex films. During the storage of latex, Zn^{2+} concentration had an impact on MST ($P = 0.000$), VFA ($P = 0.002$), and phosphate concentration ($P = 0.000$), yet no effect on alkalinity ($P = 0.059$) and pH ($P = 0.577$). The trend of MST in compounded samples was similar to that observed in latex. Maximum tensile strength of 15.58 MPa was observed at the Zn^{2+} concentration of 125.58 ppm, the sample without adding zinc. The sample with the highest Zn^{2+} concentration (360 ppm) showed a maximum tear strength of 44.37 MPa. Hence, this study concluded that higher zinc levels impaired an effect on physicochemical properties by reducing the stability of natural rubber latex, and there was no significant effect on physico-mechanical properties like tensile and tear strength of latex.

Keywords: Mechanical stability time; storage time; tear strength; tensile strength; zinc ion concentration



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Identification of an Alternative Natural Bleaching Agent for the Chemical Used in Crepe Rubber Manufacturing

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Pale crepe and sole crepe rubber are regarded as the purest form of natural rubber in the market and are widely used in the production of pharmaceuticals and surgical products that come into touch with the human body. Color is the main factor affecting the quality of crepe rubber, with enzymatic and yellow discoloration being the predominant types during the process. Enzymatic discoloration is caused by melanin formation through phenol and amino phenol, while yellow discoloration is attributed to carotenoid pigments in the luteoid phase. To avoid enzymatic and yellow discoloration, sodium bisulphite or sodium metabisulphite, and sodium para toluene thiophenate (SPTT) are commonly used. However, SPTT is toxic, and it has a monopoly market. In this study, two natural alternatives were tested as bleaching agents (NBA). Comparatively, NBA-1 showed high reducing power, and it contained peroxidase and aloesin which help to form active radicals and inhibit melanogenesis. Based on the chemical composition of NBA-2, it also had a bleaching ability. These alternatives were separately added before coagulation in the process of making crepe rubber. The prepared crepe rubber sheets were subjected to raw rubber tests, including the Lovibond color index test, P_o/PRI, Mooney viscosity, volatile matter, and nitrogen, and ash contents, to ensure that the crepe rubber sheets meet the average specifications. Although NBA-1 and NBA-2 met the average specification for crepe rubber, they did not significantly improve the color of the crepe rubber sheets. Therefore, further research is required to ensure the concentrations of NBA. Disruption of the color of crepe rubber due to the natural color of NBA-2 was able to be minimized with activated charcoal treatment. Furthermore, isolating presumptive compounds from NBA-2 would be a good approach for further research.

Keywords: Commercial bleaching agents; crepe rubber; natural bleaching agents



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Determination of the Compatibility of Waste Polyvinyl Chloride and Acrylonitrile Butadiene Rubber

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Acrylonitrile butadiene rubber is known as Buna-N and due to its oil resistance, it is a workhorse in the automotive industry. On the other hand, polyvinyl chloride is one of the most significant thermoplastics in the plastics industry, second only to polyethylene, with a global annual manufacturing capacity of considerably more than 30 million tons. Disposal of polyvinyl chloride is done via incineration. This polymer's high chlorine concentration makes complete combustion challenging to accomplish, and in addition, when it breaks down thermally, hazardous dioxins and furans are produced, and incorrect incineration conditions fuel public outrage. A stabilizer system is essential for ensuring the prolonged durability of polyvinyl chloride articles throughout their service life. Calcium carbonate was used as the filler as it is an ideal ingredient in this context to react with hydrogen chloride. In this study, the compatibility between the polyvinyl chloride pipes' powder with acrylonitrile butadiene was tested by comparing the distribution of tensile strength and tear strength of the prepared sample. There is no difference between the tensile strength and tear strength of the test samples from the same sheet ($P > 0.05$). Therefore, this data allowed for the conclusion that the integration of polyvinyl chloride and acrylonitrile butadiene rubber has been accomplished effectively. The resulting polymer composite demonstrated a tensile strength of 3.77 MPa, a modulus of 2.35 MPa, and a tear strength of 18.04 N/mm. This combination not only displays compatibility but also provides the final composite with good physical properties. This discovery suggested that this composite material has the potential to be enhanced further and used as an effective raw material in product development in a variety of industries.

Keywords: Compatibility; polyvinyl chloride-acrylonitrile butadiene rubber blends; stability; waste polyvinyl chloride



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Effect of Savinase Enzyme on Deproteinizing Skim Crepe Rubber

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Savinase enzyme produced by *Bacillus licheniformis*, could be utilized to treat skim latex aiming mitigation of its nitrogen content by breaking down proteins and hence to be used for value-added products. However, this protein breakdown process may have adverse effects on the physico-mechanical properties of skim crepe rubber. Therefore, this study was conducted to prepare and characterize skim crepe rubber treated with savinase. Varying amounts of savinase enzyme (0, 1, 2, 3, and 4 mL/L of skim latex) were used to treat skim latex samples. After coagulation, skim laces were prepared, and their raw rubber properties such as nitrogen, dirt, ash, and the volatile matter contents were measured according to ISO standards. The Fourier Transform Infrared Spectroscopy (FTIR) analysis, a method for identifying chemical compounds, was conducted specifically to analyze the presence and impact of the savinase enzyme. Skim crepe vulcanizates were then formulated and physico-mechanical properties including tensile strength, tear strength, hardness, and elongation at break were tested. When adding 2 mL of savinase to 1 L of skim rubber, the percentage nitrogen content of the skim crepe was decreased by about 90% compared to the untreated skim crepe rubber ($P < 0.05$). The skim crepe vulcanizates untreated with savinase exhibited higher physico-mechanical properties such as tensile strength, elongation at break, tear strength, and hardness ($P < 0.05$). However, the vulcanizate treated with 2 mL/L savinase demonstrated improved tensile strength and hardness compared to other treated samples ($P < 0.05$). It was observed that tear strength increased proportionately with increasing savinase concentration up to 3 mL/L of skim latex. In conclusion, the physico-mechanical properties of skim rubber latex can be enhanced by utilizing a savinase concentration between 2.0–3.0 mL/L of skim latex, and concentration of 2 mL/L was identified as the most effective for preparing skim crepe rubber vulcanizates with improved tensile strength and hardness.

Keywords: Enzyme; protein; savinase; tear strength; tensile strength



Determination of Cure and Physico-mechanical Properties of Natural Rubber-based Green Composites Developed using Corn Husk Fiber/Corn Husk Powder

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The twenty-first century has witnessed a remarkable trend towards natural fiber-based green rubber composites due to their ecological sustainability, cost efficiency, readily retrievability, low energy consumption, and high mechanical properties. Kenaf, sisal, jute, coir, and hemp fiber reinforcing behaviors with natural rubber (NR) have been evaluated, but corn husk fiber (CHF) with NR was lacking. Therefore, two types of fillers, CHF filler and corn husk powder (CHP) filler, were prepared using corn husk leaves. CHF filler, a cellulosic fiber was extracted using sodium hydroxide and thereafter alkali treatment, sodium chlorite bleaching, and oxalic acid hydrolysis were carried out to remove residual impurities and reduce the fiber size. CHP was the dehydrated, finely ground corn husks at 100°C. Extracted CHF was characterized using Fourier-transform Infrared Spectroscopy (FTIR) and thermogravimetric analysis (TGA). Two separate NR-composite series were prepared using ribbed smoked sheets (RSS-1) at different concentrations and the cure and physico-mechanical properties were compared with carbon black (N 660-FEF)-filled NR composite. The CHP series consisted of five concentrations from 20 to 40 phr at 5 phr intervals, while the CHF series consists of four levels from 1.5 to 3 phr at 0.5 phr intervals in the presence of silane-69 coupling agent. All the blends showed acceptable scorch and cure times, while the CHF series showed an increased state of cross-linking. CHP series was not the perfect match for control (N 660-FEF) but its hardness ranged from 40 to 47 IRHD, and control showed 41.41±0.743 IRHD. Tensile strength, modulus at 100% elongation, and elongation at break of the CHF series showed no significant difference compared to its controls prepared with FEF and CaCO₃. Hardness ranged from 41 to 43 IRHD and showed an increasing pattern with CHF loading, while its two controls ranged at 40.3±0.496 IRHD. The abrasion volume loss of the CHF series was lower than the two controls. Overall, the CHF series showed its potential for reinforcing NR in the presence of a coupling agent, while its 2.5 phr level was the best performing treatment level.

Keywords: Carbon black; corn husk fiber; Fourier-transform infrared spectroscopy; silane-69; thermogravimetric analysis



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Increasing Phosphorus Solubility of Eppawala Rock Phosphate Using Sintering Process

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Limited solubility of Eppawala Rock Phosphate's (ERP) confines its use being a phosphorus (P) fertilizer in perennial crops. Sintering process can enhance the solubility of ERP by modifying the crystalline structure and improving water interaction. The objectives of this study were to evaluate sintering process on P solubility of the ERP and increase solubility of ERP by sintering it with additives such as soda-lime glass and acidic soil. In this investigation, ERP underwent sintering with acidic soil from a tea nursery and soda-lime glass additives in varying weight ratios: 1:1, 1:2, and 2:1. Totally seven treatments were prepared: (i) ERP: Soil 1:1, (ii) ERP: Soil 1:2, (iii) ERP: Soil 2:1, (iv) ERP: Glass 1:1, (v) ERP: Glass 1:2, (vi) ERP: Glass 2:1, (vii) Unsintered ERP. All data were subjected to analysis of variance (ANOVA) and means were separated using Dunnett test using Minitab 18 software. According to the results, sintering processes led to differences ($P < 0.05$) in P content in the prepared sample compared to pure ERP (16.49%). Glass: ERP ratio of 1:2 showcased the highest total P content (21.98%) and citric acid solubility (0.0206%). The latter affected on enhancing P content significantly ($P < 0.05$). Meanwhile, ERP: soil ratio of 2:1 exhibited a P content of 15.03%. Total P content as P_2O_5 varied across the samples being the highest percentage in ERP: Glass ratio of 1:2 (21.98%) and the lowest in the ERP: Soil ratio of 2:1 (15.03%). ERP: Glass ratio of 1:2 showed the highest solubility (0.0206%) whereas the pure ERP had the lowest citric acid solubility (0.005%). Despite recognizing the impact of sintering and medium/ratio choices on P solubility, further research is required to fully understand specific crystalline structure interactions induced by sintering and to optimize conditions for enhanced solubility. These findings demonstrated that the sintering process significantly influences P solubility in ERP which in turn affect P availability for the use by plants.

Keywords: Eppawala rock phosphate; phosphorus solubility; sintering; sustainable agriculture



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Preparation of Epoxidized Natural Rubber Using Centrifuged Natural Rubber Latex at Room Temperature

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Epoxidized natural rubber (ENR) is a modified version of natural rubber (NR) by the introduction of an epoxy group randomly to the *cis*-1,4-*polyisoprene* chains. Using epoxidation of NR, the nonpolar NR chains are made relatively polar and hence increase the air permeability and oil resistivity which are otherwise poor in neat NR. To prepare the ENR in latex stage, it requires extreme temperatures under nitrogen saturation using deproteinized natural rubber latex. In this study, ENR was prepared at room temperature and under ambient conditions using commercially available high ammonia centrifuged natural rubber (HANR) latex. The reaction was carried out using freshly prepared peracid by combining 1:1 acetic anhydride and hydrogen peroxide solutions in the presence of a non-polar surfactant at room temperature under normal air. In the Fourier Transform Infrared (FTIR) spectrum, the peaks at 1240 cm^{-1} and 870 cm^{-1} for the symmetric and asymmetric stretching of the epoxide rings respectively were clearly visible after the reaction when compared to that of the control HANR. Further, two new peaks at 2.7 and 1.3 ppm in the $^1\text{H-NMR}$ spectrum assigned respectively to methine and methyl protons of epoxidized *cis* 1,4-*polyisoprene* coexisted with peaks at 1.68, 2.05, and 5.1 ppm of methyl, methylene, and unsaturated methine protons of *cis* 1,4-*polyisoprene*. This evidences the successful epoxidation at room temperature conditions. The green strength of ENR was nearly two times that of HANR even after a 2-h reaction time. Thus, this method can prepare ENR under ambient conditions, which is a highly demanded raw material to manufacture high thermal stabilized and high ozone resistance products from NR.

Keywords: Ambient conditions; characterization; epoxidized natural rubber latex; high ammonia natural rubber

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Shooting Ability of Cardamom (*Elettaria cardamomum*) with Fly Ash as a Supplement in *In-vitro* Nutrient Medium

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Elettaria cardamomum (Cardamom) is one of the oldest cash crops. It has two primary propagation methods, via seeds or division of subterranean rhizomes. Moreover, vegetative propagation techniques are highly prone to disease infections. Hence, *in-vitro* propagation would be a logical alternative. Further, fly ash (FA), a residue substance similar to activated carbon, is obtained as a result of burning of coal. Though FA exist as problematic solid waste, it is a soil ameliorate and revealed to have great potential in agriculture. Accordingly, this study aimed to evaluate the effect of FA in *in-vitro* shoot multiplication of cardamom and to determine the best concentration of FA as supplement. Seedlings were sub-cultured on five culture media, prepared (5 treatments including control) with the basal medium formulated by Murashige and Skoog, supplemented with benzyl adenine (BA) by incorporating FA at various concentrations. Differences were observed with regard to their number of new shoots, number of leaves, length of longest shoot, dry and fresh weight of stem, roots and leaves for 10 wk. As treatments T1 - MS medium + 1 mg/L BA + 0 g/L of FA, T2 - MS medium + 1 mg/L BA + 20 g/L of FA, T3 - MS medium + 1 mg/L BA + 40 g/L of FA, T4 - MS medium + 1 mg/L BA + 60 g/L of FA, T5 -MS medium + 1 mg/L BA + 80 g/L of FA used. Results showed that there was a growth suppression identified in almost every measured growth parameter thus in the absence of FA, better growth was observed. T1 (control) was different from other treatments in number of leaves ($P = 0.0457$). However, apart from T1, highest mean shoot height (6.57 ± 2.05), number of leaves (8.07 ± 2.52), number of shoots (1.67 ± 0.52) yielded in T2, T3, T4, respectively. The highest fresh weight of leaves (0.12 ± 0.05), stem (0.23 ± 0.08), and root (0.08 ± 0.04) were yielded in T2 and T3. Further, the highest dry weight of root (0.018 ± 0.018), leaves (0.013 ± 0.006), and stem (0.026 ± 0.016) yielded in T2, T4 and T5, respectively. Based on the results, in the absence of FA (T1), better yield was observed. However, apart from T1, when numerically compared, seedling treated with low concentration of Fly ash yielded better growth (T2 and T3) than higher concentrations (T4 and T5).

Keywords: Cardamom; fly ash; MS media; shoot multiplication; supplement



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Selection of Promising Genotypes from 2017 Hand Pollination Progeny to Reduce the Breeding Cycle in *Hevea*

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Traditional rubber breeding is a lengthy process, taking 25-30 years due to the perennial nature of rubber trees. The study focused on accelerating genetic improvement by selecting superior genotypes at an early stage. The objective of this study was to expedite the *Hevea* breeding cycle by identifying promising genotypes in 2017 hand-pollinated (HP) progeny of 47 new clones. Growth parameters such as girth, bark thickness, average yield, and leaf area were recorded and analyzed to identify the top-performing genotypes. Gene expression study with the rubber elongation factor (REF) gene was also used to select the best genotypes. According to the results of the initial studies, four genotypes namely 2017 HP 59, 2017 HP 60, 2017 HP 63, and 2017 HP 67 with the most favourable characteristics were selected. Subsequently, the latex from these genotypes was examined for colour and physiological parameters, including sucrose, inorganic phosphorus, thiol, dry rubber content, and total latex volume. Notably, all four latex samples exhibited dark colours. The physiological parameter analysis indicated that genotypes 2017 HP 59 and 2017 HP 60 displayed potential for high latex production. To further validate the genetic traits of these promising genotypes, the expression of REF gene was examined. The results revealed upregulation in the gene expression of genotypes 2017 HP 59 and 2017 HP 60. In addition, statistical analysis was conducted to assess the correlation between each growth parameter, and cluster analysis was performed, with subsequent confirmation through ANOVA test. Based on these analyses, genotypes 2017 HP 63, 2017 HP 67, 2017 HP 7, 2017 HP 11, 2017 HP 66, 2017 HP 68, and 2017 HP 39 were identified as suitable timber clones. With morphological, physiological, and molecular analysis genotypes 2017 HP 59 and 2017 HP 60 may be considered suitable for direct large-scale evaluation as latex clones. This would bypass the small-scale evaluation phase, saving approximately 10-12 years of the breeding cycle. Timber clones identified in the present study will be useful for the rubber timber processing industry.



Keywords: Breeding cycle; hand pollination; rubber; superior genotypes



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Optimization of Suitable Solvent Mixture and Swallowing Time for the Development of Liposomes with Thin Film Hydration Technique

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Utilization of liposomes is a novel emerging technology for the encapsulation and delivery of bioactive agents. Liposomes are small vesicles composed of lipid bilayers. The current study focused on developing liposomes with thin film hydration technique from soya lecithin by using the selected suitable organic solvents and evaluating the most effective swallowing time. Organic solvent mixtures of chloroform: ethanol and hexane: ethanol (9:1 v/v %) were used to dissolve the soya lecithin. Lipid thin layer was prepared by evaporating solvent using a rotary evaporator at 50°C under 150 mbar. The developed thin layer was hydrated with 75 mM phosphate buffer (pH 7.4) at a predetermined ratio of lecithin to buffer as 1:150 w/v %. The mixture was allowed to undergo a swallowing process at an ambient temperature for different periods as 120, 150, and 180 min. The synthesized liposomes were separated by centrifugation at 3,000 rpm for 30 min. The most suitable solvent mixture and swallowing time were determined based on the yield of synthesized liposomes which was determined by gravimetrically. The morphology and particle size of liposomes were determined using an optical microscope and a particle size analyzer. Significantly the highest liposome yield ($P < 0.05$) was obtained from ethanol with hexane as $25.62 \pm 0.03\%$ compared to ethanol with chloroform as 15.84% at 120 min of swallowing time. Swallowing time significantly affected the liposome yield. Significantly the highest liposome yield was recorded at 180 min with the value of $42.31 \pm 0.02\%$ followed by 150 min and 120 min with the values of 33.25% and 25.62%, respectively. Microscopic observations confirmed the formation of multi-lamellar vesicle structures in the synthesized liposomes. The mean particle size of the synthesized liposome was 631.12 ± 0.03 nm under the optimized conditions. The study revealed that the mixture of ethanol and hexane with 180 min swallowing time is more effective in synthesizing liposomes to achieve the highest yield percentage.

Keywords: Multi-lamellar vesicle; organic solvents; soya lecithin; swallowing time.



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A Comparison of the Antimicrobial Activity of Various Parts of *Syzygium cumini* (L.) Skeels in Jaffna District, Sri Lanka.

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In recent years, there has been interest in researching and developing new antibiotics from various sources to fight microbial infections. Antibacterial properties are found in numerous medicinal plants that can prevent the growth and virulence of different microbes during infections. Thus, there is a great deal of attention given to examining antimicrobial activity of herbal material and its evaluating methods. *Syzygium cumini* L. Skeels is an important medicinal plant which grows in the Jaffna district. In its various parts, there are numerous phytochemical compounds that have multiple pharmacological effects such as hypoglycemic, diuretics, analgesic, anti-inflammatory, antioxidant, and gastro-protective effects. The main objective of this study was to investigate the antimicrobial effect of ethanolic, methanolic, and aqueous extracts of different parts of *S. cumini* plant. The agar well diffusion method was used to analyze antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* while the standard disk diffusion method was used for the *in-vitro* antifungal activity against *Mucor* sp., *Aspergillus* sp., and *Fusarium* sp. Based on the antibacterial activity results, it was found that the ethanolic seed coat extract had the largest inhibition zone diameter against *S. aureus* (27.56±0.46 mm) while the aqueous extract of bark showed the lowest inhibition zone against *Pseudomonas* sp. (11.50±0.66 mm). Based on the antifungal activity results, it was revealed that the methanolic extract of the leaf had the lowest diameter of inhibition of fungal growth against *Fusarium* sp. (15.87±0.73 mm) while the aqueous extract of bark showed the highest diameter of inhibition against *Aspergillus* sp. (37.93±0.80 mm). The study found that the ethanolic seed coat and methanolic leaf extracts had greater antibacterial and anti-fungal activities than the other extracts obtained from the plant. In the future, drug leads may be generated for treating infectious diseases caused by microbes using the seed coat and leaves of *S. cumini* plant.

Keywords: Agar well diffusion; antibacterial activity; antifungal activity; antimicrobial activity; inhibition zone



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Investigation of *In-Vitro* Propagation Protocol for Gerbera (*Gerbera jamesonii*) Using Shoot Cuttings

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Gerbera belonging to the family Asteraceae is a popular cut flower and potted plant widely used in the floral industry all over the world. The lack of quality plant materials of Gerbera to establish commercial cultivation is a limitation to expanding the industry. Three experiments were conducted to investigate the complete protocol for *in-vitro* propagation of Gerbera by optimizing the media compositions for *in-vitro* shooting, rooting, and acclimatization under local conditions. Experiments on *in-vitro* shooting (Experiment 01) and rooting (Experiment 02) were designed with five treatments (Shooting; GS1, GS2, GS3, GS4, and GS5 and rooting; GR1, GR2, GR3, GR4, and GR5) with ten replicates in Completely Randomized Design (CRD). In Experiment 03, two potting media *viz.*, A (sand: coir dust in 1:1) and B (soil: sand: compost in 1:1:1) were used in evaluating the best media for acclimatization. Two-sample t-test and one-way ANOVA were used for the analysis of data in Experiment 03. Among the five treatments used for the growth of shoots (GS), GS1 (MS+ 7 mg/L BAP + 0.3 mg/L NAA), GS2 (MS + 2 mg/L BAP) and GS3 (MS + 1 mg/L BAP + 0.5 mg/L NAA) were identified as the best media with no significant difference in its performances for subsequent shooting in sub culturing. GS3 was selected as the best medium for shooting as it reported better performances under a minimum amount of plant hormones in the media. Experiment 02 revealed no significant differences among rooting media *viz.*, (GR) of GR1 ($\frac{1}{2}$ MS+ 1 mg/L IAA), GR2 (MS + 1 mg/L IAA), and GR3 ($\frac{1}{2}$ MS + 0.75 mg/L IBA + 0.5 mg/L NAA) for *in-vitro* rooting. GR3 was selected as the best rooting medium in which less amount of plant growth regulators had been used. No significant differences were recorded in two acclimatization media for the selected growth parameters in Experiment 03, hence potting media B (soil: sand: compost in 1:1:1) may be recommended as a cost-effective media for commercial production of *in-vitro* grown Gerbera plants.

Keywords: Acclimatization; *in-vitro*; plant growth regulators; rooting; shooting



Ecologically Sustainable Synthesis of Silver Nanoparticles from Various *Mandevilla* Varieties: Unraveling Antioxidant, Photocatalytic, and Antimicrobial Properties

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The synthesis of silver nanoparticles (AgNPs) through eco-friendly methods is a widely explored area in nanotechnology. The objective of this study was to evaluate the antioxidant, photocatalytic, and antibacterial properties of AgNPs synthesized from five *Mandevilla* genus varieties: red (ManR), white (ManW), yellow (ManY), pink (ManP), and bicolor (ManBi). Water extracts from these plant varieties were prepared, and phytochemical analyses confirmed the presence of compounds crucial for AgNPs formation. Optimization of the water extract and AgNO₃ solution mixture involved exposure to diverse temperature conditions and time intervals. The study included determining total flavonoid content, total phenolic content, total antioxidant capacity, and a DPPH free radical scavenging assay. Photocatalytic activity was assessed using methyl orange and NaBH₄. *Staphylococcus aureus* and *Escherichia coli* were used to determine the antibacterial activity. Four varieties synthesized AgNPs at 60°C for 60 min, except for ManR. The AgNPs synthesis was confirmed by the color change from colorless to brown and the clear maximum surface plasmon resonance peaks in the range of 420 nm to 480 nm from the UV-visible spectrophotometry. Scanning electron microscope analysis showed that ManYAgNPs were spherical and 80 nm in diameter. The band gap energy study showed that synthesized AgNPs were semiconductors. The antioxidant activity of AgNPs was comparatively higher compared to water extracts. The free radical scavenging activity of water extracts and AgNPs was approximately equal. The maximum absorption peak of methyl orange at 460 nm was reduced slightly by 4000 mg/L AgNPs, indicating a slight degradation of methyl orange. The photocatalytic activity of 267 mg/L and 4000 mg/L AgNPs was enhanced by NaBH₄. The antimicrobial activity of the water extracts was higher compared to AgNPs for *E. coli* and *S. aureus*, except for ManP water extract and AgNPs, where the antimicrobial activity against *S. aureus* was equal. Based on the results of this study, AgNPs display a broad range of properties that could contribute to the treatment of diseases and the remediation of pollution by azo dyes.

Keywords: Silver nanoparticles (AgNPs); *Mandevilla* leaves; antimicrobial; antioxidants; eco-friendly; photocatalysis



Precise Selection of Superior *Hevea* Genotype(s) from 2014 Hand-Pollinated Progeny

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The hybridization and selection of rubber (*Hevea brasiliensis*) aims to assess the genetic potential of planting material to produce superior genotypes. Early selection is crucial for strengthening and shortening the breeding program. However, the perennial nature of *Hevea* is the major limitation in rubber breeding. Twenty high and low-yielding accessions at the mother plant nursery of 2014 hand-pollinated progeny were selected for the current study with the objective of identifying high yielding and Tapping Panel Dryness (TPD) tolerant/susceptible clones. Average yield, girth, and bark thickness were measured as phenotypic characters. The yield performance of each genotype and bark anatomy was evaluated. Gene expression analysis was also performed with Catalase (*HbCAT*) and Superoxide dismutase (*HbSOD*) genes to evaluate the proneness for TPD. According to the results of the regression analysis, girth, bark thickness, bark anatomical parameters such as the diameter of latex vessels, and the number of latex vessels per unit area (Density) positively correlated with rubber yield. The analysis of the above parameters divided the genotypes into two major clusters such as high and low-yielding groups. Biochemical parameters such as sucrose, Inorganic phosphorus, thiol, polyphenol, dry rubber, and total solid content were measured for latex diagnosis. The genotypes 2014HP-21, 2014HP-78 and 2014HP-102 showed comparatively higher yields. The genotypes 2014HP-56, 2014HP-57, and 2014HP-86 showed the potential to be stimulated due to their high sucrose and low inorganic phosphorus contents. However, further studies needed to reconfirm these results. All other genotypes showed low values in latex physiological parameters, indicating below-average performance for commercial recommendation. Genotypes 2014HP-21 and 2014HP-98 showed higher tapping panel dryness traits than other selected 2014HP genotypes, so gene expression of *HbCAT* and *HbSOD* genes was performed to further confirm the proneness. The fold difference value was significantly downregulated in the genotypes 2014HP-21 and 2014HP-98. Accordingly, it can be confirmed that these two genotypes are prone to TPD. In conclusion, this study reiterates the importance of early selection in *Hevea* breeding and provides insights into the genetic potential of different genotypes. It identifies promising high-yielding genotypes, as well as those with specific latex characteristics and pinpoints the vulnerability of certain genotypes to TPD.

Keywords: Bark anatomy; catalase (CAT); gene expression; *Hevea brasiliensis*; super-oxide dismutase (SOD); tapping panel dryness (TPD)



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Study on Effect of Different Light Qualities and Durations on Growth and Development of *In-Vitro* Plants of *Cocos nucifera* L.

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In coconut tissue culture, an extended *in-vitro* acclimatization period is observed after transferring *in-vitro* developed shoots to a 16/8 h (light/dark) photoperiod. Typically, during this period the rate of shoot elongation and overall growth increment tend to decrease. Consequently, *in-vitro* propagated clonal coconut plantlets derived from unfertilized ovaries and Dikiri plantlets propagated using zygotic embryos require approximately two and a half years and six months, for the *in-vitro* acclimatization process, respectively. This study was aimed to investigate how different light qualities and durations can expedite the *in-vitro* acclimatization of *Cocos nucifera* L. The effect of different light qualities was evaluated on the growth and development of *in-vitro* propagated coconut plantlets through two subculture intervals, each lasting 1 ½ months, under six different light treatments; red 16/8 h, red 24 h, red: blue 16/8 h, red: blue 24 h, white 16/8 h (control) and white 24 h. Data analysis was done by ANOVA using Minitab 17 statistical package and Fisher's LSD test for multiple comparisons to detect the differences between treatments means. For clonally propagated coconut plantlets, the most favorable results in terms of height increment (2.15 cm) and the number of new leaves (0.8) were achieved under blue LEDs and red LEDs in a 1:1 ratio, with a 16/8-h light cycle. Conversely, white LEDs with a 16/8-h light cycle yielded the highest weight increment (1.37 g), while continuous exposure to white LEDs resulted in the highest number of primary root initiations (0.59). In the case of Dikiri coconut embryo rescue methodology, the exposure of plantlets to red LEDs significantly promoted new leaf initiation (1.33), fresh weight increment (3.1 g), and elongation of internodal length (11.49 cm). Notably, the formation of the highest number of primary roots (1.1) was observed under both the red LEDs with a 16/8-h cycle and white LEDs with continuous light exposure.

Keywords: Embryo rescue; *in-vitro* acclimatization; LED light; light quality and duration; unfertilized ovary culture



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Paper ID: NSALS24-070

Evaluation of Morphological and Molecular Variation of an Out-Crossing Progeny of Moorock Tall Coconut Cultivar

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Moorock Tall is an estate selection, recommended as an alternative to improved coconut cultivar CRIC60. This selection has been specifically targeted for its high kernel content and thickness. The open-pollinated seednuts from this estate have been used as planting materials mainly in the wet and wet intermediate zones of Sri Lanka for more than three decades. However, no comprehensive study has been done to compare the performances of the mother palms at Moorock estate and their progenies after the initial selection. This research was conducted to compare the important fruit components and genetic variation between Moorock estate mother palms and their open-pollinated progeny planted at Lenawa estate. The two populations were represented by randomly selected 50 palms from each population and the molecular diversity was studied using six SSR markers developed for coconut, CnCIR3, CnCIRB12, CNZ10, CNZ06, CNZ44, and CAC65. The molecular analysis revealed slightly higher mean genotype number, allele number, gene diversity, heterozygosity, and polymorphic information content in the Lenawa estate compared to the Moorock estate. However, the same number of alleles were observed at two estates except for markers CnCIRB12 and CNZ06. At the locus CnCIRB12, only a single allele was present in the Moorock samples while five new alleles were observed in the progeny implying possible cross-pollination with outside pollen sources. However, our sample size was not sufficient to make firm conclusions in this regard. With respect to gene diversity, the Lenawa estate showed a higher diversity only at CnCIR3, CnCIRB12, and CNZ44 while the Moorock estate showed a higher diversity at the other three loci CNZ10, CNZ06, and CAC65 revealing no clear genetic variation between the parent population and its progeny. Furthermore, the two-sample t-test conducted to compare economically important traits; kernel weight and kernel thickness revealed non-significant differences showing similar performances of the parent population and its progeny.

Keywords: Coconut; fruit traits; microsatellite; Moorock tall; open-pollinated progeny



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Paper ID: NSALS24 -98

Development of *In-vitro* Shooting and Rooting Protocol for Carnation (*Dianthus chinensis*)

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Dianthus chinensis (Carnation) belonged to family Caryophyllaceae is one of the most important cut and potted plant in the world floriculture market due to its unique features such as beauty, diversity of colours, and especially for the excellent keeping quality. This study was aimed to develop a cost-effective, uniform plants for commercial production of Carnation throughout the year by using *in-vitro* techniques. Through this, we enable to cater the demand in local market by minimizing the importation of plant materials. The effects of explant type (Explants with single shoot and explants with multiple shoots), different concentrations, and combinations of plant growth regulators (6-benzyl amino purine [BAP], indole acetic acid [IAA], and thidiazuron) and charcoal (with or without) on new shoot and root induction of Carnation were studied using 15 replicates arranged in Completely Randomized Design (CRD). The explants with multiple shoots in MS medium supplemented with 1 mg/L BAP and 0.1 mg/L IAA, without charcoal was the best medium for the new shoot initiation and the increment of shoot height of Carnation ($P < 0.05$). Even though proper rooting was not observed within the given study period of three months, root primordia was observed in MS medium supplemented with 2 mg/L IAA and 0.5 mg/L thidiazuron, without charcoal. Therefore, further studies are needed for the confirmation of the results to develop complete protocol for *in-vitro* production of Carnation.

Keywords: Charcoal; explants; plant growth regulators; root growth



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Paper ID: NSALS24-105

Viability of Microencapsulated *Streptococcus thermophilus* STI-15 in Stressed Conditions with Ultrasound Treated Soy Protein Isolate as Wall Material

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Probiotics are live microbial strains that beneficially affect the host by improving intestinal microbial balance when consumed in adequate doses (10^7 CFU/g of product) and therefore have been widely utilized as additives to produce functional foods. The substantial loss of probiotic viability during stressed conditions such as storage and gastrointestinal transit can be reduced by entrapping probiotic cells into the polymer matrix. In this study, probiotics (*Streptococcus thermophilus* STI-15) were entrapped in ultrasound (22 Hz) treated soy protein isolate (USPI) and soy protein isolate (SPI) microcapsules by freeze-drying method (-80°C and 72 h). The performance of microencapsulated cells, with free cells (FC) as control, was investigated against sequential temperature conditions (4°C and -18°C for 28 d). Each treatment was replicated three times to assess the viability of probiotics. After being freeze-dried with glycerol as a cryoprotectant, the survival rate of USPI encapsulated cells was 94.22 ± 0.47 . Microcapsules treated with USPI showed a higher ($P < 0.05$) viability under freezing condition (-18°C) at d 0 (8.172 ± 0.005 vs. 8.044 ± 0.001 log CFU/g), day 7 (8.158 ± 0.005 vs. 7.941 ± 0.001 log CFU/g), day 14 (8.130 ± 0.005 vs. 7.803 ± 0.01 log CFU/g), day 21 (8.050 ± 0.005 vs. 7.379 ± 0.02 log CFU/g) and day 28 (7.937 ± 0.007 vs. 7.236 ± 0.03 log CFU/g) compared to the control. The viability of *S. thermophilus* was reduced upon the storage ($P < 0.05$). This study demonstrates that encapsulation of *S. thermophilus* in ultrasound-treated soy protein isolate is an effective technique of resisting extreme temperature conditions during storage.

Keywords: Microencapsulation; probiotics; soy protein isolate; *Streptococcus thermophilus*; ultrasound; viability



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Paper ID: NSALS24-113

Effect of Plant Growth-Promoting Rhizobacteria Isolates on Growth and Yield of Rice (*Oryza sativa* L.)

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Plant growth-promoting rhizobacteria (PGPR) are beneficial soil microbes that settle on plant roots and promote plant growth through a range of processes. The use of PGPR as inoculant biofertilizer is considered an environmentally friendly strategy for enhancing growth and yield of rice. Therefore, the objective of the present study was to investigate the effect of rhizobacteria isolates on the growth and yield of rice variety Bg 300. Rhizobacteria were isolated from roots and rhizosphere soil of rice and the weed "kudamatta" (*Fimbristylis miliacea*) from a no-fertilizer paddy field of the Rice Research and Development Institute, Batalagoda in Yala in April 2023. Of seventy rhizobacteria colonies obtained, eight rhizobacteria isolates namely R'-1'-01, R'-1'-02, R'-1'-03, W'-1'-01, W'-1'-02, W'-1'-03, Root B1, and Root B2 were selected based on morphological characteristics. The treatments consisted of eight rhizobacterial isolates, a negative control (devoid of PGPR or fertilizer), and a positive control (N, P, K fertilizer application recommended by the Department of Agriculture). The isolated bacteria were inoculated to rice plants of the variety Bg 300 grown on pots (arranged according to a Randomized Complete Block Design [RCBD] with three replications, each having two pots and three seedlings per pot) using the root-dipped inoculation method. Growth data such as plant height, leaf chlorophyll content, leaf greenness, number of tillers, number of panicles, dry weight of root and shoot per plant and yield data 1000 grain weight and yield per plant were recorded. Significantly higher growth and yield performances were recorded from plants treated with the rhizobacterial isolate W'-1'-2 ($P < 0.05$) and values obtained for various parameter *viz.*, number of panicle (15.000), dry weight of root (16.287), dry weight of shoot (26.107) were on par with those of DOA NPK fertilizer recommendation values. Upon biochemical and molecular characterization and identification, the rhizobacteria isolate W'-1'-2, may be used as a potential inoculant biofertilizer for enhanced growth and yield of Bg 300 rice variety in future.

Keywords: Bg 300; fertilizer; plant growth-promoting rhizobacteria; rice; yield



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Paper ID: NSALS24-114

Morphological and Molecular Characterization of Biotypes of the Rice Brown Planthopper (*Nilarpavata lugens* Stål) Collected from Different Locations in Sri Lanka

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The brown planthopper (*Nilapavala lugens* Stål) is a major pest in rice cultivation, causing a significant yield loss. Existing brown planthopper (BPH) resistant rice varieties have become susceptible to BPH in recent years. This may be due to the emergence of new biotypes of BPH populations in Sri Lanka. Therefore, the objective of the present study was to investigate morphological and molecular variations among BPH populations in different areas of Sri Lanka. Samples of BPH were collected from areas *viz.*, Gampaha, Kegalla, Kandaketiya, Dehiattakandiya, Batalagoda, and Meegahakiula during the 2023 Yala season. Morphological observations of samples were made using a Stereo microscope. Molecular analysis was done by PCR amplification of the COI gene regions of each sample using LCO 1490, HCO 2198 and mt COI primers. Significant variations in morphology (length and color of insects, antenna, wing, and hind leg) were observed among insect populations. Interestingly, the number of plaque organs of antennae, length of the flagellum in antenna, length of the sheath with stylets, the number of teeth in spur, and the number of spines in hind legs were found to vary among insect populations. No differences were observed in mouthparts and venation on the wings of the insect collection. PCR amplifications resulted in expected band lengths in all samples from Gampaha, Dehiattakandiya, and Meegahakiula, but variations in band length were observed from samples collected from Kandaketiya, Kegalle, and Batalagoda. This study provides some insights into morpho-molecular variations of BPH populations in Sri Lanka. Molecular characterization using sequence data of amplified products, especially samples obtained from Kandaketiya, Kegalle, and Batalagoda areas will be useful in confirming the results of the present study for future agricultural implications for developing rice varieties with BPH resistance.

Keywords: Biotypes of brown planthopper (*Nilapavala lugens* Stål); rice (*Oryza sativa*); morphology of insects; molecular characterization

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ANIMAL PRODUCTION & TECHNOLOGY

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Evaluation of Protein and Lipid Oxidation of *Oreochromis niloticus* Stored under Frozen Storage

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Nile tilapia (*Oreochromis niloticus*) is a widely cultured and consumed freshwater fish worldwide. Sri Lankan fisheries sector hence acknowledged it as the “Food fish of the 21st century”. However, the protein and lipid degradation of the fish is a common problem associated during storage. The present study investigated the changes in protein and lipids in Nile tilapia harvested from Hadapanagala reservoir, Monaragala during a 42-d frozen storage (-20°C). Fish samples (250±50 g) were harvested and stored at -20°C for 42 d. Protein oxidation was assessed by analyzing carbonyl concentration (nmol/mg protein) and SDS-PAGE analysis while lipid oxidation was assessed by analyzing malonaldehyde concentration (mg MDA/kg of fish) and DPPH radical scavenging activity. All protocols were triplicated, and data were subjected to one-way ANOVA. According to findings, there were significant differences in carbonyl content, malonaldehyde content, and antioxidant activity among different storage periods ($P < 0.05$). Carbonyl content which was the protein oxidation indicator reached to its maximum from 0.11±0.02 (d 1) to 10.56±0.34 nmol/ mg protein (d 21) while SDS-PAGE showed distinct band patterns of the d-42 samples compared to the initial samples. The malonaldehyde concentration (MDA mg/kg) as the lipid oxidation indicator decreased from d 01 (0.03 ± 0.01) to d 42 (0.01 ± 0.01), while the antioxidant activity (%) of the samples reached its minimum from d 01 (27.81±2.67) to d 35 (3.91±2.08) indicating oxidation of lipid with storage ($P < 0.05$). These findings lead to the conclusion that the storage temperature and time have significant effects on oxidation of proteins. Hence, preserving fish at -20°C for prolong period is not very effective in terms of preserving nutrients and extending the shelf life.

Keywords: Carbonyl concentration; lipid oxidation; *Oreochromis niloticus*; post-harvest losses; protein oxidation



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Mixed-cropping of *Brachiaria brizantha* (Bread Grass) with Selected Fodder Grasses for Improved Forage Production

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Feeding standards of ruminants could be significantly improved through the high productivity of quality forage. Cropping system is one of the important factors that affects forage productivity. Mixed-cropping of fodder grasses with pasture legumes is popular among the farmers. However, mixed-cropping of fodder grasses with non-legume pasture is not very popular. The major objective of this experiment was to evaluate the productivity of different species of fodder grasses with non-legume pasture grasses cultivated as mono-cropping and mixed-cropping methods. The experiment was carried out with the following treatment: CO3 mono-cropping (T₁), CO4 mono-cropping (T₂), super Napier mono-cropping (T₃), Guinea grass mono-cropping (T₄), Bread grass mono-cropping (T₅), CO3+Bread grass mixed-cropping (T₆), CO4+Bread grass mixed-cropping (T₇), super Napier+Bread grass mixed-cropping (T₈), Guinea grass+Bread grass mixed-cropping (T₉). This experiment was conducted from July to November 2022. Completely Randomized Design was used as the experimental design with two replicates. The forage performance was measured using growth parameters such as plant height, number of tillers, and leaf length, dry matter yield, and nutritional composition. Growth parameters were measured in the 2nd, 4th, and 8th wk after planting. The yield and nutritional composition were measured 8 wk after planting. Collected data were subjected to Analysis of Variance. The means were separated using the Turkey test at 0.05 significance level. Growth parameters after 2 wk of planting revealed that the plant height (23.51±0.06 cm) and number of tillers (2.63±0.38) were higher for CO3+Bread grass mixed-cropping (P < 0.05). The results of the growth parameter after 4 wk of planting showed that leaf length (42.11±3.56 cm) was higher for CO4 mono-cropping (P < 0.05). The results after 8 wk of planting indicated that plant height (153.23±9.68 cm) was significantly higher for CO3+Bread grass mixed-cropping, leaf length (82.15±2.48 cm) was significantly higher for super Napier mono-cropping, and dry matter yield (1928±49.5 g) was significantly higher for CO4 mono-cropping. The results of the nutritional analysis revealed that the dry matter content (18.97±0.55%) was higher for Guinea grass+Bread grass mixed-cropping (P < 0.05). There was no difference in chemical composition such as crude protein and crude fiber among the treatments (P > 0.05). In conclusion, the mono-cropping of fodder grasses had a higher productivity compared with mixed-cropping of fodder and non-legume pasture grasses.

Keywords: Bread grass; dry matter yield; mixed-cropping; mono-cropping



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Impact of Inflationary Shocks on Dairy Products Consumption in Ampara District, Sri Lanka

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Dairy industry is one of the important subsectors in the livestock industry of Sri Lanka. Approximately 437.2 to 709.8 mL of milk or other dairy products should be consumed daily, based on recommendations. Inflationary shocks across global food commodities may have a significant impact on dairy consumption in low- and middle-income countries such as Sri Lanka. In this study comparison of peak level inflation between 2021, 2022 and 2023 was considered. Ampara district was selected as the study sample to represent regional Sri Lanka to study about the people who are primarily agrarian with middle to low income. The aim of this study was to determine the demographic and economic factors affecting the consumption of dairy products in Ampara district Sri Lanka. Data were collected through a consumer survey using a structured questionnaire in Kalmunai, Sainthamaruthu, Karaitheevu, Samanthurai, and Akkaipattu GN divisions. The sample included a total of 100 dairy consumers. A regression analysis was carried out to assess the impact of inflationary shock on the consumption of dairy products such as milk powder, yoghurt, and curd. Further, a regression analysis and descriptive statistic were carried out to find the relationship between number of demographic and socio-economic characteristics of consumers such as gender, education level, household size, income level, disposable income, level of employment, unavailability, unique selling point, purchasing power, health consciousness, purchase intention, and perceived knowledge that affect dairy products consumption before and after the inflation. According to the data gathered, levels of milk powder, yoghurt, and curd consumption before and after inflation were 1372 vs 608 g, 312.80 vs 137.60 mL, and 1690 vs 710 mL, respectively. These results indicated that the consumption of dairy products have been reduced drastically after the inflation. The household size, education level, and level of employment were significant ($P < 0.05$) where the variables are decisive in dairy products consumption. Finally, these findings suggest the dairy industry to use different marketing strategies and promote the products through various channel and improve the product innovation in future.

Keywords: Dairy consumption; inflationary shocks; level of employment; regression analysis



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Paper ID: NSALS24-071

Consumer Attitudes on Fresh and Processed Meat Quality: A Case Study from School Children in Akuressa Divisional Secretariat, Matara District

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Food safety issues spotlighted in worldwide discussions, particularly in the meat industry. Therefore, meat quality should be given more thought by farmers, distributors, marketers, and policymakers. In order to determine the factors influencing consumer attitudes about meat quality, this study was carried out with a focus on school children in the Akuressa divisional secretariat of Matara district. Two hundred consumers were selected non-randomly with convenience criteria given the limited time and surveyed using a pre-tested structured questionnaire. The primary data were analyzed using the Microsoft Office Excel (2007) and IBM SPSS Statistics 20 software. The independent variables used in the econometric model are grade, income, mother's education, father's education, nutritional purpose, taste purpose, gender, father's occupation, mother's occupation, and market type. All respondents consumed at least one kind of meat product while only 0.03% of respondents did not consume any type of meat. Ninety-nine percent of the respondents had established their meat consumption pattern at their child age. Only one percent of students established meat consumption at grade five. The religious believes (1%), empathy for killing animals (1.5%), and dislike of eating meat or meat products (0.5%) were the most popular reasons for not being meat consumers. The "meat cleanliness" (72.8%) was the most concerning factor at time of purchasing and 69.7% of respondents concerned "quality standards" as the first. The meat color (56.4%), freshness (63.1%), tenderness (2.5%), juiciness (54.4%), marbling (54.9%), and softness (53.8%) were the other most concerning quality parameter at time of purchasing. Income, gender, and grade significantly affected the consumer attitude toward meat quality. There were no significant correlations between the attitude index and the mother's or father's occupations, mother's or father's education level and knowledge about the protein. In conclusion, it is apparent that conventional demographic characteristics had significant impact on consumer attitude on meat quality, but the factors related to social status do not.

Keywords: Cleanliness; consumer attitude; quality standards; regression model; religious believes



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Antimicrobial Resistance and Multi Drug Resistance of *Escherichia coli* and *Salmonella* in Beef Production Chain and its Associated Environment in Kandy District, Sri Lanka

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Beef production is the world's third largest meat sector, only after poultry and swine. Antimicrobials are administered to live cattle for therapeutic and nontherapeutic uses. Antimicrobial resistance (AMR) and multi drug resistance (MDR) are on the rise globally and viewed as threats to public health. To understand any presence of AMR and MDR in local beef production chain, this study was carried out using 64 *Escherichia coli* and 20 *Salmonella* strains that had been previously isolated from bovine manure, beef, and associated wastewater from cattle farms plus beef stalls in Kandy district of Sri Lanka. The phenotypic determination of AMR was done following the recommended methods in CLSI for 10 routinely used antimicrobials in both human and veterinary medicine; ampicillin, amoxicillin/clavulanic acid, ceftriaxone, chloramphenicol, ciprofloxacin, erythromycin, gentamycin, imipenem, tetracycline, and sulfa trimethoprim. MDR was defined as an acquired non-susceptibility to at least one agent in three or more antimicrobial categories. Each *E. coli* and *Salmonella* isolate were resistant (100%) to erythromycin, confirming their inherited resistance. The phenotypic antimicrobial resistance profiles of *E. coli* to ampicillin, tetracycline, and sulfa trimethoprim were 43.8, 18.8, and 7.8%, respectively. Isolated *Salmonella* was resistant to tetracycline (35.0%), ampicillin (15.0%), and sulfa trimethoprim (5.0%). The percentage of resistance of *E. coli* isolates to at least one antimicrobial was 45.71, 44.0, and 100% in bovine manure, farm wastewater, and beef samples, respectively. On the other hand, resistant rates of *Salmonella* to at least one antimicrobial were 100, 50.0, and 50.0% in bovine manure, farm wastewater, and wastewater from beef stalls, respectively ($P < 0.05$). About 5.71, 16.0, and 75.0% of isolated *E. coli* from bovine manure, farm wastewater, and beef samples were MDRs with resistance to ≥ 3 classes of antimicrobials, respectively. No MDR was revealed in isolated *Salmonella* species. The prevalence of both *E. coli* and *Salmonella* AMR as well as MDR *E. coli* in beef production is an alarming issue for public health, emphasizing the urgency of implementing efforts to reduce antimicrobial usage in Sri Lanka.

Key words: Bovine; erythromycin; manure; resistant rate; wastewater



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Paper ID: NSALS24-076

Asparagus (*Asparagus falcatus* L) Inulin as a Fat Replacer in Chicken Nuggets

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Inulin is a fructan-type non-digestible carbohydrate with proven beneficial effects on health and can be found naturally in some plants, including chicory, jerusalem artichoke, asparagus roots, dahlia tubers, garlic, leeks, and onions. The demand for meat and processed meat products is increasing globally. Although processed meat products are nutritious and delicious, they are considered disease-promoting food due to the lack of dietary fiber and higher fat content. There is a current trend to develop functional meat products with inulin due to its specific characteristics as a fat replacer. This study was carried out to determine the effect of replacing chicken fat with asparagus inulin on the quality traits of chicken nuggets. Water-based inulin gels were prepared using extracted asparagus and commercial inulin powders. Chicken nuggets were prepared separately replacing chicken fat with water-based inulin gels to reach final inulin gel percentages of 2, 4, and 6 (w/w). A sensory evaluation was conducted to select the best inulin gel inclusion levels using Friedman test. The selected products' physicochemical properties, proximate analysis, and microbial analysis were determined over a 28-d frozen storage. The data were subjected to one-way analysis of variance (ANOVA) and Tukey's comparison of the means test ($P < 0.05$) using Minitab 17 software. Commercial inulin gel at 2% and extracted asparagus inulin gel at 4% were selected as the best inclusion levels. The fat content of nuggets was significantly reduced with the incorporation of inulin; 9.80% (control), 9.27% (commercial inulin), and 8.20% (asparagus inulin). During the storage, the pH value and water holding capacity were decreased while TBARS values were increased in all samples. In addition, total plate counts increased during storage in all samples within acceptable limits, and all the samples were negative for *Salmonella* spp. The texture profile analysis and color values were comparable ($P > 0.05$) among the samples. The results revealed that asparagus inulin can successfully substitute fat in chicken nugget production without altering the meat quality parameters.

Keywords: Asparagus; commercial inulin; dietary fiber; fat replacer; TBARS



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Paper ID: NSALS24-079

Effect of Organic Manure on Improving Soil Conditions and Yield of CO₃ Grass in Boralanda Farmland

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Farm animal manure has been utilized in agriculture as a source of nutrients in addition to improving soil properties. CO₃ is a perennial fodder grass extensively cultivated in Sri Lanka due to its high production. This study was carried out (1) to determine the improvement of soil conditions upon the application of cattle manure, poultry manure and synthetic fertilizers and thereby (2) to propagate CO₃ grass at Boralanda farm. Eight treatments were assigned following the recommendations with three replicates in a Randomized Complete Block Design (RCBD): (i) 100% poultry manure, (ii) 100% cattle manure, (iii) 100% synthetic fertilizer, (iv) 50% poultry manure and 50% synthetic fertilizer, (v) 50% cattle manure and 50% synthetic fertilizer, (vi) 50% poultry manure and 25% cattle manure and 25% synthetic fertilizer, (vii) 25% poultry manure, 50% cattle manure and 25% synthetic fertilizer treatments and (viii) with free of any fertilizer supply (control). A soil analysis was conducted to determine pH, electrical conductivity (EC), available water content (AWC), bulk density (BD), total nitrogen (N), and available phosphorous (P) contents before and after fertilizer applications. Basal fertilizer was applied after field preparation, and three node cuttings of CO₃ were planted at spacing of 60 × 60 cm. The growth parameters of the CO₃, including the number of tillers, number of leaves per plant, leaf length (cm), leaf width (mm), and tiller length (cm), were recorded weekly for 6 wk. All data were subjected to analysis of variance (ANOVA) and mean separation was conducted following Tukey's test at P < 0.05. The results indicated that 100% cattle manure exhibited the highest total N (3.69%) and available P (0.42%) contents while 50% poultry manure and 50% synthetic fertilizer displayed the highest AWC (17.89%). Additionally, 100% synthetic fertilizer treatment demonstrated the lowest BD (1.39 g/cm³). CO₃ grass exhibited the highest growth when treated with 100% synthetic fertilizer. Further, 100% poultry manure treatment exhibited the most favorable performance in terms of the number of tillers (4.3), number of leaves (19.13), and tiller length (10.44 cm) (P < 0.05) whereas 100% cattle manure treatment showed significantly higher growth in leaf length (171.5 cm) and leaf width (126.4 mm). In conclusion, application of 100% cattle manure and 100% poultry manure resulted considerable improvements in soil properties as well as in CO₃ plant growth in Boralanda farmland.

Keywords: Boralanda farm; CO₃ grass; farm manure; organic fertilizer



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Paper ID: NSALS24-083

An Assessment of Performances, Constraints, and Potential to Increase the Production in Small-Scale Dairy Farms; A Case Study in Kotmale Area of Nuwara Eliya District, Sri Lanka

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Kotmale area has a high concentration of small-scale dairy farmers in Sri Lanka. This investigation aimed to study the constraints and opportunities of small-scale dairy farms in Kotmale area, Nuwara Eliya District, Sri Lanka. This study was conducted by personally interviewing randomly selected 200 dairy farmers in Kotmale area. The secondary data supported primary qualitative and quantitative data. Data were analyzed using Microsoft Excel Office package (2016). The majority of dairy farmers (78%) were male while low youth contribution (6%). The majority of the respondents (97%) stated their constraint in milk marketing as low price offered for milk sales. The lack of good quality semen for artificial insemination was a significant issue for most farmers (95%). The foot and mouth disease was a significant concern in the area, with 19% of farmers reporting incidents of the disease. In addition, poor sanitation, low water availability, and other financial issues were significant constraints faced by farmers. Well-distributed cattle types, long-time farming experience, a market expansion for milk products, and efficient veterinary service are opportunities for small-scale dairy farmers in Kotmale area. These findings will help to improve the productivity and sustainability of small-scale dairy farming in the Kotmale area.

Keywords: Constraints; dairy farming; Kotmale area; opportunities; small-scale



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Paper ID: NSALS24-086

Effect of Different Fruit Peel Powders on Meat Quality Traits of Marinated Spent Hen Meat

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Spent hen meat is considered as a byproduct of poultry egg industry. Because of its higher collagen content and greater cross-linking, spent hen meat is tougher than broiler meat and has a limited use in the meat industry. Hence, this study was conducted to determine the efficacy of papaya peel powder and pineapple peel powder on quality traits of marinated spent hen breast meat. Spent hen breast meat was marinated separately for 24 h at 4°C using three different marination pastes containing 2% of ginger powder (control), ripen pineapple peel powder and ripen papaya peel powder. Water holding capacity of the marinated spent hen meat from all treatments significantly decreased over the storage period. Degradation of proteins over the storage led to changes in the muscle fibers, affecting their ability to retain water. The cooking loss of marinated meat from all treatments increased with the storage time ($P < 0.05$). Spent hen meat marinated with papaya peel powder had the lowest cooking loss value. The pH values of marinated spent hen meat ranged between 4.70 and 5.81. The spent hen meat marinated with pineapple peel powder showed a higher pH value than its counterparts ($P < 0.05$). TBARS values of the marinated spent hen meat were significantly increased over the storage period ($P < 0.05$). The a^* and b^* values of spent hen breast meat marinated with all marinades increased ($P < 0.05$) with the storage time. In conclusion, marination with papaya peel powder and pineapple peel powder had a significant positive effect on the quality traits of the spent hen meat. Papaya peel powder and pineapple peel powder can be used to modify the quality traits of spent chicken meat.

Keywords: Breast meat; papaya peel powder; paste marination; pineapple peel powder; TBARS



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Paper ID: NSALS24-089

Evaluation of Meat Quality and Sensory Properties of Wild Boar Meat as a Potential Substitute for Pork during the Food Crisis in Sri Lanka

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Sus scrofa affinis represents the specific subspecies of wild boar in Sri Lanka. It has been identified as one of the main pests for agriculture in the country, and recently, there is a discussion to lift the ban of slaughtering wild boars completely. The study was carried out during June to October 2022 to assess the suitability of wild boar meat (WBM) as a viable alternative to commercial pork in addressing food shortages in Sri Lanka. A comparative analysis of meat quality and sensory attributes were conducted between WBM, village pig meat (VPM), and commercial pork (COP). Employing purposive sampling, a survey was conducted to assess the potential of WBM. The proximate composition and meat quality parameters such as protein content, ash content, pH, water holding capacity (WHC) and meat colour of WBM, VPM, and COP obtained from local markets were determined. Additionally, a sensory evaluation was carried out to compare the organoleptic characteristics of these meat types. Data were analysed using SPSS and results indicated that 71.6% of participants consumed pork, with 68.7% expressing a preference for WBM. However, the majority of respondents lacked awareness regarding the significance of WBM. They supported the idea of wild boar culling due to its protein potential, its status as an agricultural pest, and its potential contribution to the tourism industry, with a recommendation to conserve the local gene pool. The findings revealed that WBM exhibited higher crude protein content, WHC, and b* value and lower ash content, pH, and L* value compared to COP ($P \leq 0.05$). The overall acceptability of WBM was significantly greater than that of the other two meat types, and assessors preferred ($P \leq 0.05$) the colour of WBM over that of VPM and COP. These results confirmed the potential of WBM as a sustainable substitute for pork, especially during food crises in Sri Lanka.

Keywords: Meat quality; potential substitute; wild boar meat



Effect of Refrigerated Temperature on the Shelf Life of Eggs Collected from Chicken Reared in Battery Cage Systems

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Chicken egg is a highly nourishing food which contains essential proteins and lipids. However, egg quality deteriorates with the storage, which has an impact on customers' acceptance. Objective of this study was to identify the physicochemical alterations and microbiological contaminations of eggs collected from chickens raised in battery cage systems during refrigerated storage. A total of 150 medium sized eggs (52.81 ± 2.13 g) were collected from Hyline Brown birds raised in battery cage systems at 28 wk of age and stored in a refrigerator (4°C). At day one, shape index was determined, and *Salmonella* test was performed. Egg quality traits such as shape index, Haugh index, yolk colour, yolk index, grade, yolk and albumen percentage, yolk to albumen ratio, pH values of yolk and albumen, shell thickness, weight loss, and hard-boiled egg structure were examined daily up to d 60 under refrigerated temperature. *Salmonella* test resulted in negative observations. The average shape index of eggs was 78.99 ± 1.84 . Haugh index of eggs ranged from 98.76 ± 2.67 to 89.51 ± 1.17 during 60-d storage ($P < 0.05$). Yolk index was comparable during storage time ($P > 0.05$). Gemological microscopic observation and FTIR results did not show a significant difference. Grade was constantly remained in AA grade from d 1 to d 60 according to USDA grading conditions. Yolk and albumen percentages and yolk to albumen ratio did not show significant differences during the 60-d storage ($P > 0.05$). The pH of yolk decreased ($P < 0.05$) from d 1 (17.97 ± 0.10) to d 60 (6.60 ± 0.04) while that of albumen increased ($P < 0.05$) from d 1 (18.06 ± 0.20) to d 60 (8.97 ± 0.02). However, weight loss of eggs significantly increased from 0.14 ± 0.02 to 3.59 ± 0.22 during the 60-d storage. In conclusion, chicken eggs can be kept under refrigerator temperature (4°C) up to 60 d based on the physiochemical changes observed during the experiment.

Keywords: Egg grade; egg quality; egg white; egg yolk; *Salmonella*



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Development of a Novel Meat Spread Incorporated with Chicken Liver

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Chicken liver, a nutritious edible offal meat, is widely consumed globally due to its high mineral, vitamin, and protein contents. The availability of commercial products from chicken liver is currently limited in Sri Lanka. This study was aimed to develop a novel product that could be a potential solution to the underutilization of chicken liver in Sri Lanka. The chicken liver incorporated spread was produced by mincing chicken liver and thigh meat, mixing them with corn starch, sugar, ice, spice mix, and other ingredients, packing in airtight containers, and finally steam cooking at 80°C for 45 min. Preliminary trials were conducted to identify the optimal ratio of chicken liver to thigh meat based on consumer preference for flavor. Best ratio was selected as 1:1 and the recipes were developed in four different flavors as garlic, spicy, and cheese and chili, along with a control. Lipid oxidation (TBARS assay), pH, color, and texture properties of the prepared spreads stored at 4°C were measured up to 28 d. A proximate analysis was conducted to determine the crude protein, crude fat, moisture, and ash contents. Two sensory analyses were conducted using 30 untrained panelists each, parallel to it for two age groups (below 25 years and above 25 years) to ascertain the consumer acceptability of the four products. According to the results, hardness, springiness, cohesiveness, and adhesiveness values from all the treatments were comparable ($P > 0.05$). Moisture, fat, and protein contents of the four treatments were different ($P < 0.05$) while the ash content of all four treatments had no significant difference ($P > 0.05$). TBARS values increased during the storage ($P < 0.05$), but within the accepted limits. Cheese and chili flavored spread obtained the highest overall acceptability from the panelists under 25 years while the highest overall acceptability of the panelists above 25 years was obtained by the spicy flavored spread. In conclusion, all four recipes were suitable as value added products with a vast range of consumers and as a potential solution to the underutilization of chicken liver in Sri Lanka and they can be stored for 28 d at 4°C.

Keywords: Lipid oxidation; overall acceptability; poultry by-product; textural properties



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Assessing the Synergy between Effective Microorganisms and Vermitea Technology in Reducing Chemical Fertilizer on Fodder Cultivation

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This study was designed to evaluate Effective Microorganisms (EM) and Vermitea Technology (VT) to reduce chemical fertilizer use in fodder cultivation in Sri Lanka. The experiment used a Randomized Complete Block Design with three blocks, assessing four fodder cultivars: hybrid Napier (Pakchong/Super Napier), red Napier, fodder Sorghum (Sugar graze), and fodder Maize (Weera). Four fertilizer mixtures were applied: 100% chemical fertilizer (F1), 50% chemical fertilizer + EM (F2), 50% chemical fertilizer + EM + Vermi Tea (F3), and 50% chemical fertilizer + Vermi Tea (F4). Organic manure was uniformly added at 25 kg per plot to improve soil organic matter. Soil samples were collected and analyzed for pH and electrical conductivity before land preparation. Harvest intervals differed for Napier varieties, sugar graze, and maize (60 and 75 d), respectively. Plant growth parameters (height, number of leaves, leaf length, width, and tillers) were measured according to standard methods. The weekly field data were recorded for growth parameters from three randomly selected plants/clumps in the middle of each plot. Yield and brix values were measured at harvest. Despite no significant differences ($P > 0.05$) observed in growth parameters among cultivars and fertilizer treatments, notable trends emerged. Plant height was higher in F2 for maize, red Napier, and super Napier; F4 excelled with sugar graze. Leaf length was higher in F2 for maize, sugar graze, and super Napier, while F1 benefited red Napier. F4 showed wider leaves for maize and sugar graze, more tillers for red Napier and F2 for super Napier. The number of leaves was higher in F4 for sugar graze and red Napier, F2 for maize and F3 for super Napier. Brix values were highest in F3 for maize, red Napier, and super Napier; F4 led for sugar graze. Sugar graze consistently showed the highest average yield (31.06, 29.88, 27.84, 32.10 tons/acre across treatments), respectively. In conclusion, various growth parameters in different fodder cultivars were notably enhanced by specific fertilizer treatments, particularly F2 and F4. While sugar grazes consistently excelled in yield, fertilizer choice significantly impacted growth across cultivars. This underscores the potential for tailored fertilizer strategies to enhance fodder cultivation in Sri Lanka, aiming to reduce chemical fertilizer usage while optimizing productivity.

Keywords: Brix value; effective microorganisms; leaf length; Napier; Sorghum; tiller

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Evaluation of Protein and Lipid Oxidation in Yellowfin Tuna Loin (*Thunnus albacares*) Stored under Frozen Temperature (-20°C)

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Tuna fish is one of the most popular seafood dishes in the world. They contain high amounts of essential nutrients including essential amino acids and fatty acids. During storage, postharvest changes in proteins and lipids occur which affect the flavor, texture, nutritive value, and color of the fish. It reduces the economic value of the fish. This study was aimed to evaluate the changes in tuna fish protein and lipids stored under frozen temperature (-20°C). Tuna loin samples were taken from a seafood processing plant, and they were portioned to 25 g pieces and stored under frozen conditions. Samples were taken from the loin of the fish and dark muscles were not selected. After storing the samples, they were analyzed for protein oxidation (DNPH assay and SDS-PAGE), and lipid oxidation (TBARS and DPPH) up to 42 d. Data were analyzed using Minitab 20. DNPH test was used to identify changing carbonyl content during the protein oxidation and there was a significant difference between the results under frozen storage conditions ($P < 0.05$). The highest carbonyl concentration was observed on d 1 (20.359 ± 0.592 nmol/mg) but from d 3 to d 42 there was no significant difference between the carbonyl concentrations ($P > 0.05$). According to the SDS-PAGE results, proteins were partially degraded even with -20°C storage revealing the protein oxidation. Within the storage period, there was a significant change in malonaldehyde level (d 1: 0.098 ± 0.001 mg MDA/L, and d 42: 0.114 ± 0.011 mg MDA/L) ($P < 0.05$). However, DPPH radical scavenging assay had no significant changes during the storage period (d 1: $51.853 \pm 0.312\%$ and d 42: $48.830 \pm 0.660\%$) ($P > 0.05$). In conclusion, lipids and protein in tuna fish tend to oxidize with storage at frozen temperature and produce secondary compounds which can result in producing unfavorable organoleptic characteristics.

Keywords: DNPH assay; DPPH assay; lipid oxidation; protein oxidation; SDS-PAGE; TBARS assay



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Seafood Consumption Patterns of Pregnant and Breastfeeding Women in Negombo Area, Sri Lanka

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Maternal diet and nutritional status during pregnancy and breast-feeding period are important determinants of human fetal growth and development. The current study was conducted to identify the consumption patterns and estimate the amount of seafood consumption among pregnant and breastfeeding women in Negombo area. Negombo was selected due to the reason that the population largely consumes seafood. Nutritional benefits and risk from toxic trace metal intake via seafood consumption were also assessed. A group of 350 individuals was selected as the sample, comprising 235 (67.14%) pregnant and 115 (32.86%) breast-feeding women covering all maternity clinics (14) in the Negombo area. A questionnaire consisting of demographic characteristics and preference for seafood consumption was used for data collection alongside key personal interviews. There was no significant difference in the demographics among pregnant and breast-feeding women ($P > 0.05$). The majority of individuals (67.43%, $n=236$) preferred to consume meat products over seafood as their protein source. Large-sized and medium-sized fish were least preferred to purchase and consume by both pregnant and breastfeeding women compared to small-sized fish. Both groups were reluctant to consume prawns, crabs, clams, oysters, mussels, and processed fish products due to reasons including medical advice and allergies. A significantly lower number of participants preferred to take freshwater fish as a nutrient alternative to seafood ($P < 0.05$). The majority of the pregnant (70.89%) and breastfeeding women (79.82%) were satisfied with their level of seafood intake. A greater proportion of respondents (78.57%) from both groups were satisfied with their access to fresh and quality seafood. There was no significant difference in the daily seafood intake of pregnant and breastfeeding women ($P > 0.05$). The mean seafood intakes were 146.86 ± 1.46 and 124.26 ± 1.28 g/day/person for pregnant and breastfeeding women, respectively. The mean dietary intakes of major nutrients were higher than the recommended levels except for iodine, and the intake of toxic trace metal contaminants was below the provisionally tolerable limits. The findings of the study provide baseline information for the scientific communities who engage in the field of maternal health and nutritional management for seafood consumption.

Keywords: Fish intake; maternal diet; nutrition; risk; shellfish



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Freshwater Fish Consumption Patterns of the Child Population in Rambewa Divisional Secretariat of Anuradhapura District, North Central Province, Sri Lanka

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Fish consumption plays a key role in providing essential nutrients for childhood nutrition. The purpose of this cross-sectional study is to investigate freshwater fish consumption patterns and its nutritional contribution to children aged 3 to 10 years in Rambewa Divisional Secretariat of Anuradhapura District, North Central Province, Sri Lanka. The area was chosen because its population predominantly consumes freshwater fish, with minimal or no intake of seafood. A questionnaire-based survey was used to collect information from a sample size of 384 children. The data were collected from the parents with the support of pre-and primary-schools. Among the surveyed children, a higher proportion (41%, n=157) confirmed fish as their primary source of animal protein. Notably, 30% (n=115) of children reported eggs as their main source of animal protein. A considerable portion of children indicated meat as the primary source of animal protein, making up 20% (n=77) of respondents. In contrast, a smaller percentage of children (9%, n=35) mentioned dairy products as their main source of animal protein. The majority of children (92%) consumed freshwater fish regularly. There was no significant difference ($P > 0.05$) in fish consumption between males (50%, n=176) and females (50%, n=177). The percentage of pre-schoolers (3-5 years) who consumed freshwater fish (33%) was lower than that of primary schoolers (6-10 years) (67%). This difference was significant ($P < 0.05$) indicating that fish consumption was significantly higher among primary school-aged children compared to pre-schoolers. The most preferred cooking method was fried fish (49.52%). Chilled-fish-curry and fish-curry with coconut milk were mentioned by 27.41% and 19.48% of respondents, respectively. Tilapia was the most popular fish species, accounting for 25% of the preferences. Freshwater fish allergies were reported by only 2.6% of those surveyed. The estimated mean intake of fish among the surveyed children was found to be 9.8 kg/year, which was lower than the recommended intake of 11.8 kg/year. This study provides baseline data on preferences, consumption patterns, nutritional contribution, and safety issues of freshwater fish intake in children in the area that could be useful to medical and nutrition professionals.

Keywords: Childhood nutrition; fish intake; pre-schoolers; primary-aged children; tilapia



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How Spirulina (*Arthrospira platensis*) Powder Effects on the Growth Performance, Color Enhancement, and Retention in *Aulonocara baenschi*

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Body coloration is a major factor in determining the economic value of ornamental fish. Color fading is a major problem in the ornamental fish industry, especially in Cichlids. Artificial colorants can enhance the color but have less effect on color retention. Many complaints related to the color fading of cichlids come after about two weeks from the exportation. This is one of the biggest barriers to the development of the export industry. This study was conducted by using Spirulina (*Arthrospira platensis*), rich in proteins and carotenoid pigments to test the growth performances, color enhancement, and retention of Cichlids (*Aulonocara baenschi*). Growth performances were tested using different concentrations of *A. platensis* powder. Five different concentrations of *A. platensis* powder were selected to balance the requirement of protein levels of fish (0, 3, 6, 9, and 12%) incorporated with commercially available fish feed in triplicates. This experiment was carried out under two phases, the color enhancing (for 56 d) and color retention period (for 30 d). The tested feeds were given, ensuring 10% of their body weight of marketable-sized fish, per day within 50 cm × 50 cm × 50 cm glass tanks with 15 fish per tank. Photographs of fish were taken once in 2 wk and Red, Green, Blue (RGB) values of those photos of fish skin were considered. The mean RGB values of fish after 56 d in each treatment were 184.74±1.59, 128.36±1.58, 113.39±2.64, 75.19±1.63, and 75.05±1.60, respectively (P < 0.05) and those at the end of the color retention period (30 d) were 184.63±1.48, 133.58±1.36, 116.71±2.57, 77.15±2.23, and 75.71±1.78, respectively (P < 0.05). Specific growth rates (SGR) of fish after 56 d in all treatments were 1.24±0.028, 1.55±0.025, 1.79±0.028, 2.19±0.022, and 2.20±0.023, respectively (P < 0.05). These values were confirmed with the mean HSV in the increment of color intensities. The growth rate, color development, and color retention in *A. baenschi* were enhanced with an increase in the concentration of *A. platensis* powder up to 9% and these factors were approximately constant in the concentration greater than 9%. This study revealed that the most suitable treatment for color retention and growth of *Aulonocara baeinschi* is 9% spirulina powder incorporated treatment.

Keywords: *Arthrospira platensis*; cichlid; color fading; color retention; spirulina



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Assessing the Impact of Aqueous Extracts of *Ulva fasciata* and *Gracilaria corticata* on Seed Germination and Seedling Growth of Bean (*Phaseolus vulgaris* L.) and Chilli (*Capsicum annum* L.)

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Seaweed, a potential resource in Sri Lanka, contains proteins, peptides, amino acids, lipids, pigments, polysaccharides, phenols, cytokines, gibberellins, auxins, and abscisic acid, which stimulate seed germination and increase crop yield. Some crop seeds exhibit poor germination, and seaweed aqueous extracts can be used to enhance seed germination. This study was aimed to evaluate the potential of aqueous extraction of *Ulva fasciata* and *Gracilaria corticata* on the germination of chilli (*Capsicum annum* L.) and bean (*Phaseolus vulgaris* L.). The experiment followed a Completely Randomized Design (CRD) with three concentrations (4, 8, and 12%) of aqueous extract of *Ulva* and *Gracilaria*. All treatments were conducted in triplicate, and data were analyzed using one-way ANOVA at a 95% significance level. When comparing the aqueous extracts of two seaweed species on seed germination of bean, the 12% *U. fasciata* aqueous extraction exhibited the highest germination percentage (22.65±0.06%), and 4% *U. fasciata* aqueous extraction showed the highest mean shoot length (22.65±0.06 cm). In addition, *U. fasciata* aqueous extraction at 8% showed the highest mean root (18.34±0.19 cm), mean leaf area (9.62±0.18 cm²), mean dry weight (0.18±0.00 g) and vigor index-II (7.64±0.19) and III (1363.5±3.50). In chilli seed germination, when comparing the two seaweed aqueous extraction treatments, 12% *G. corticata* treatment showed the highest germination percentage (73.00±0.57%). In addition, 4% *G. corticata* aqueous extraction exhibited the highest mean shoot length (4.56±0.01 cm), the highest mean fresh weight (0.08±0.001 g) and the highest vigor index-II (2.10±0.04) while 12% *G. corticata* aqueous extraction showed the highest mean fresh weight (0.08±0.001 g), vigor index-I (329.96±2.42) and III (889.9±23.9). According to all the results, there was a significant difference between treatments and control (P<0.05). The results indicated that *Ulva fasciata* aqueous extraction enhances the seedling growth of beans whereas *Gracilaria corticata* aqueous extraction treatments enhance the seedling growth of chilli.

Keywords: Aqueous extraction; *Gracilaria corticata*; seed germination; *Ulva fasciata*; vigor index



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Implications of COVID-19 and Measures for Adaptation in the Aquaculture Industry: Empirical Evidence from Badulla District, Sri Lanka

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The global aquaculture industry has encountered significant challenges during the COVID-19 pandemic, particularly affecting developing nations. This underscores the critical need for management strategies at local and national levels to expand our understanding of the pandemic's impact on aquaculture. This study includes primary data obtained from Badulla district, Sri Lanka, as an empirical case study to assess the impacts of COVID-19 on the aquaculture sector. The questionnaire-based survey, conducted from March to May 2021, gathered information during the weeks following the initial island-wide lockdown and the early stages of various government relief packages, and the collected data were analyzed using descriptive statistics. The survey which involved 142 respondents revealed that most of the participants were engaged in aquaculture with 47.18% of all three sectors related to fish farming, sales, and processing. The respondents consisted exclusively of male individuals employed full-time in the aquaculture industry, with ages ranging from 23 to 67 years old. However, 35% of individuals engaged in aquaculture for additional income. The results highlighted that 94% of the surveyed farmers experienced adverse effects from COVID-19, emphasizing the widespread impact on those engaged in full-time aquaculture. Furthermore, the study's findings illuminate the various strategies employed by participants in the aquaculture sector to mitigate challenges such as a shortage of employees, feed scarcity, and financial difficulties during the COVID-19 pandemic. The strategies employed by respondents in the aquaculture industry to address the challenges posed by COVID-19 encompassed the implementation of practical measures. These measures included refraining from directly adding feed into the lake, temporarily halting breeding practices, and engaging in the immediate sale of the catch at the lakeside, as well as the preparation of dried fish using surplus food fish. Our study unveiled a variety of strategies adopted by fish industry stakeholders, including farmers, processors, and sellers, to counteract negative impacts. These measures involved diversifying products, exploring new markets, enhancing production efficiency, and embracing technology and innovation. In conclusion, current statistics are crucial for drafting both national and international policy actions that support Sri Lanka's aquaculture operations in the face of future pandemics.

Keywords: Aquaculture practitioners; COVID-19 pandemic; food fish; income; recommendations



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Impact of Economic Crisis Towards the Performance of Ornamental Fish Industry in Sri Lanka

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The ornamental fish industry has become a major sector among the economically important sectors of Sri Lanka in recent times. However, the severe economic crisis (2021-2023) has influenced the ornamental fish industry in various ways. This study was conducted to assess the past and current status of the performance of ornamental fish industry in Sri Lanka and randomly selected 920 people engaged in the industry in Colombo, Kaluthara, Gampaha, and Polonnaruwa Districts, where it is prominent. A questionnaire survey was conducted to employ mixed-methods approach, combining quantitative analysis and qualitative analysis. It was revealed that during the economic crisis, there were negative impacts than in previous years including Covid pandemic period (2019-2021) on the performances of the ornamental fish industry with a decline (relatively 50%) in both production and export volumes. With the downturn in the national economy, the sudden fluctuations in exchange rates and increased production costs, mainly including feed, electricity, and transportation costs, had led to a reduction in both international and local market demand for ornamental fish, resulting in lower profit. Profitability had a significant positive association ($P < 0.05$) with the demand and a significant negative association ($P < 0.05$) with feed, electricity, and transportation costs. Sri Lanka Custom's data also indicated that the export volume of ornamental fish was 578,503 kg in 2021 and it was declined rapidly after 2021 to 269,101 kg due to the prevailing economic crisis. Additionally, during the economic crisis, the profitability did not have a significant association ($P > 0.05$) with labor cost and selling price since there was no significant change in labor cost and selling price. Although the majority of those engaged in the ornamental fish industry (72.31%) had not engaged in strategies to overcome these problems, the use of alternative feed (54.26%) and reduced feeding frequency (19.15%) were the main practices as mitigative strategies (27.69%). Therefore, the development of financial support, provision of training, technical support, and establishment of market linkages to promote domestic and international sales can be made as suggestions to mitigate adverse effects of economic crises on the ornamental fish industry in Sri Lanka.

Keywords: Export volume; production cost; profitability; strategies



Evaluation of the Effect of Hybridized Liquid Fertilizer Produced from Fisheries Sector By-products on Growth Performance of *Anubias nana*

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Aquatic plants are commonly utilized as ornamental plants in aquaria due to their aesthetic and economic value. Among these, the genus *Anubias* is considered as one of the most demanded aquatic plant species. This study was aimed to determine a suitable fertilizer for enhancing the growth performance of *Anubias nana* using a value-added hybrid fertilizer derived from by-products of the fisheries sector. The experiment was carried out using an 8-wk-old *in vitro* propagated uniform sample of *A. nana* plantlets where they were acclimatized in hydroponic systems using three different fertilizers. Two hybrid liquid fertilizers were prepared using fish by-products and shrimp by-products as treatments. These liquid fertilizers were hybridized by incorporating urea and Muriate of Potash (MOP) at levels corresponding to their maximum solubility. A commercially available hydroponic fertilizer was used as the control treatment. The experiment was conducted in plastic net pots following a Completely Randomized Design (CRD) with five replicates. Fertilizers were applied once a week as a foliar application, adhering to the recommended dosage for hydroponic fertilizer to ensure consistency with commercially used quantities. The growth performance of plantlets was assessed using the number of leaves, leaf area (cm²), and canopy area (cm²). These growth parameters were measured every 5 d throughout 3 wk. Data were analyzed using one-way ANOVA and Tukey's test. Out of the three treatments, plantlets in the fertilizer derived from shrimp by-products exhibited a significantly higher number of leaves (8.76±1.59). Moreover, plantlets in the shrimp by-products fertilizer demonstrated significantly higher leaf area (0.97±0.17 cm²), and canopy area (3.90±0.71 cm²). This study highlighted that the hybridized liquid fertilizer produced from shrimp by-products enhances the growth performances of *Anubias nana* at significantly higher rates compared to the other tested fertilizers.

Keywords: *Anubias nana*; fisheries sector by-products; foliar application; growth performance; hybrid liquid fertilizer



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The Status of Kite Surfing: A Case Study in Kalpitiya, Sri Lanka

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Kalpitiya lagoon is recognized as Asia's best and the world's fourth kite surfing (KS) destination because of its ideal wind, excellent water, and geographical location. Considering the existing knowledge gaps and challenges associated with KS in the Kalpitiya region, this study was structured to investigate the influence of seasonal and interannual wind variations on KS activities. Monthly wind speed data were obtained from commercial windmills at the study location from 2018 to 2023. Additionally, a purposive sampling technique was employed to select 30 interviewees, who represented a diverse range of stakeholders, including KS instructors and operators. These selected participants were then subjected to unstructured interviews to gather in-depth insights. The data analysis was executed through a blend of manual thematic analysis and descriptive analysis using the MS Excel 19 software package. The analysis of wind data revealed two distinct seasons suitable for KS. The best season is from May to September since it depends on the Southwest monsoon with a monthly mean wind speed of 7.53–7.94 m/s and from December to February, depending on the Northeast monsoon, with a monthly mean wind speed of 6.31–5.67 m/s. In addition to KS, every KS operator and hotelier engage in other tourism activities such as dolphin watching, whale watching, and snorkeling. The results indicated that approximately half of the local population is engaged in KS, either directly or indirectly, highlighting the significant role of KS in the local community. As challenges to KS, the higher cost of the equipment, and the high cost of getting and renewing the instructor license were recognized. The subsequent expansion of vegetation around the lagoon interferes with the steady wind patterns during the prime season for KS. This situation presented obstacles for both novice and seasoned kite surfers, consequently affecting the overall quality of the KS experience. Given the limited government support for the development and promotion of KS, including the provision of necessary facilities, it is crucial to foster effective management and competition within the KS sector.

Keywords: Challenges; Kalpitiya lagoon; kite surfing; strategies; wind patterns



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Current Status and Future Trends in Utilization of Seaweeds in Sri Lanka

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Seaweeds are eukaryotic, photosynthetic organisms and highly diverse with different morphological forms. In Sri Lanka, an impressive variety of seaweeds are present which belonging to 161 genera and 410 species. However, conducted studies on awareness of seaweed and its utilization among the general public are not at a satisfactory level. To address this gap, a web-based pilot survey was conducted in 2022, using a random sampling method that involved 690 individuals representing all 24 districts of Sri Lanka. During this survey, increased participation was observed from the young adults, indicating a growing interest in seaweed-related information. The primary objective of this study was to explore the awareness and utilization trends of seaweeds in Sri Lanka. The collected information included the purpose of utilization (human food, medicine, ornamental, cosmetic, animal feed, fertilizers, and water treatment), frequency of use, preference of consumption, and cultivation practices. Our findings indicated that 79% of individuals were aware of seaweed-incorporated products and 62% possessed knowledge regarding seaweed culture. In addition, according to age and gender, there was a significant difference ($P < 0.05$) in the understanding of seaweeds and their usage between coastal and non-coastal groups. The highest utilization of seaweed was recorded as human food and medicine. However, approximately 51% of individuals have expressed that they are reluctant to use items that contain seaweed. This may be due to the lack of awareness, difficulty in finding, and limited advertising of products containing seaweeds. It has been observed that individuals sometimes misclassify seaweeds as other marine organisms, such as corals. The present study infers the willingness of people to be aware more about the production of seaweed and its products. Since seaweeds are beneficial for humans, raising awareness could result in the growth of seaweed utilization and the expansion of industry.

Keywords: Awareness; consumption; current status; seaweed; utilization



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Effect of Extraction Methods on the Yield and Quality of Carrageenan from *Kappaphycus alvarezii*

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Kappaphycus alvarezii, a seaweed commercially farmed in Sri Lanka since 2012, serves as a major source of raw material for kappa carrageenan which has enormous economic potential across various industries. Only a limited number of studies have been conducted on carrageenan extracted from *K. alvarezii* in Sri Lanka. The objective of this study was to evaluate optimum extraction method of carrageenan from *K. alvarezii* seaweed. *K. alvarezii* were collected from Valaipadu farm in Kilinochchi District, Sri Lanka, and carrageenan was extracted using three different techniques; aqueous extraction, alkaline extraction, and ultrasonic assisted extraction, and spray dried to create a fine, white powder. Viscosity was measured using a 1.5% carrageenan solution at 75°C and compared with commercially available carrageenan in Sri Lanka. Among the extraction methods, alkaline extraction performed using KOH for 1 h at 85°C provided the highest yield at 54.2%, however, resulted in the lowest viscosity of 5.0 cps. Ultrasound-assisted extraction carried out at 150 W for 15 min at 90°C yielded 32.4% of carrageenan with a viscosity of 23.8 cps. Despite its lower yield of 19.33%, aqueous extraction carried out at 74°C for 1 h and 30 min, produced carrageenan with a higher viscosity of 118.2 cps. Other physicochemical parameters including clarity, texture, density, moisture content, and chemical composition of extracted carrageenan and commercially available carrageenan revealed significant differences ($P < 0.05$). Furthermore, FTIR analysis of extracted carrageenan and commercial carrageenan showed that extracted carrageenan was kappa carrageenan. Considering both yield and physicochemical properties, the ultrasound-assisted extraction method was identified as the most suitable method to extract carrageenan from *K. alvarezii* in Sri Lanka.

Keywords: Alkaline; aqueous; carrageenan; phycocolloid; ultrasound

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CROP PRODUCTION TECHNOLOGY

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Determination of Curcumin Content of Turmeric (*Curcuma longa*) Accessions Grown in Low Country Intermediate Zone, Under Coconut

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Turmeric is a prominent spice, colorant, and preservative agent obtained from the dried rhizome of *Curcuma longa*, belongs to the family Zingiberaceae, widely cultivated in Asian countries including India, China, and Sri Lanka. Curcumin is the most imperative fraction of turmeric, responsible for its biological activities including antioxidant, anti-inflammatory, anticancer, and antimicrobial effects. Studies on variations in curcumin content of different accessions of turmeric in Sri Lanka are comparatively lower. This study was mainly focused on determining the curcumin content of T12, MT23, MT6, MT26, MT19, MT3, ET2, ET8, T9, MT31, MT33 and MT5 turmeric accessions collected from different locations and cultivated thereafter at the Intercropping and Betel Research Station, Department of Export Agriculture at Dampallassa, Narammala under similar agronomic practices. Curcumin content was determined according to the ASTA (American Spice Trade Association) method 18.0. The absorbance was measured at 425 nm, using alcohol as the blank. The results clearly revealed that there were significant differences in curcumin contents among the tested turmeric accessions ($P < 0.05$). Curcumin content ranged from $0.35 \pm 0.04\%$ to $4.99 \pm 0.01\%$. From the results, it was evident that the curcumin content of T12, MT26, MT3, ET2, ET8, and MT5 complies with the range identified in the Sri Lankan standard level (3-6%). Moreover, cluster analysis revealed that all accessions were classified into three groups which will be extremely useful in initiating breeding programs.

Keywords: ASTA method; biological activities; *Curcuma longa*; curcumin; turmeric



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Impact of Different Ratios of Fish Tonic and Albert's Solution on Growth and Yield Performance of Lettuce (*Lactuca sativa* L.)

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Lettuce (*Lactuca sativa* L.) belongs to the family Asteraceae which is one of the most important leafy vegetable crops in the world. Production of quality lettuce is a major concern nowadays because it is consumed as raw fresh vegetables. There is a need to introduce an organic solution to substitute Albert's solution for production of quality lettuce in cost-effective way because production of fish tonic is a very cheaper method, and it is enriched with several nutrients. This study was conducted with the main objective to evaluate the suitability of different ratios of fish tonic and Albert's solution on growth, yield, and quality performance of lettuce. The experiment was conducted in Completely Randomized Design (CRD) with three replicates. Five different nutrient solutions; 100% Albert's solution (Control; 2 g/L of water) (T₁), 75% Albert's solution+25% fish tonic (T₂), 50% Albert's solution+50% fish tonic (T₃), 25% Albert's solution+75% fish tonic (T₄), and 100% fish tonic (T₅) (100 mL/16 L of water) were used in a non-circulating hydroponic system. Plant growth parameters (plant height, number of leaves, and plant canopy diameter), quality parameters (chlorophyll content), and yield parameters (fresh weight of shoot) were recorded. The data was subjected to ANOVA using SAS statistical software. DMRT was performed to find the best treatment. The highest plant height and number of leaves were observed in 75% Albert's solution+25% fish tonic (T₂), and the highest plant canopy and chlorophyll content were observed in 50% albert+50% fish tonic (T₃) and lowest was observed in 100% fish tonic (T₅). Among yield parameters, the highest shoot weight (42.13 g) was observed at 50% Albert's solution+50% fish tonic (T₃) and the lowest shoot weight (6.79 g) was observed at 100% fish tonic (T₅). It can be concluded that 50% Albert's solution+50% fish tonic (T₃) is an ideal nutrient solution combination for quality lettuce production in terms of yield and quality parameters under a non-circulating hydroponic system.

Keywords: Albert solution; fish tonic; hydroponics; parameters; soilless cultivation



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An Analysis of Five Picked Therapeutic Herbs' Toxicity Profiles Against Rice Weevil

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The importation of several synthetic fertilizers and pesticides into Sri Lanka has been outright forbidden due to their adverse consequences. Consequently, there was a decline in yield and a nationwide increase in food costs. This transition to organic farming had a severe impact on Sri Lanka's economy in the second half of 2021, compounded by other existing issues such as the COVID-19 pandemic. To mitigate the undesirable effects associated with artificial substances, researchers have focused on isolating prescribed drugs from botanical sources. In addressing the issue of stored grain pests, particularly, *Sitophilus oryzae*, herbal insecticides have emerged as a more reliable, affordable, sustainable, and environmentally benign alternative to synthetic pesticides. In an effort to determine the plant with the most potent insecticidal capacity against the rice weevil, alcohol-based extracts of *Lantana camara* (leaves), *Carica papaya* (seeds), *Ricinus communis* (leaves), *Calotropis gigantea* (flowers), and *Gliciridia sepium* (leaves) were used in mortality tests with four replications in a laboratory bioassay. The culturing of rice weevil was performed by using laboratory conditions at 25±1°C and 50-60% RH, allowing for classification based on morphological features, including the wider and longer rostrum of males compared to females. The comparative efficacy of botanicals against the rice weevil mortality was determined through an analysis of survival statistics. A control test using methanol as the solvent was also conducted. The effectiveness of botanicals can be ranked as follows: *G. sepium* > *C. gigantea* > *R. communis* > *C. papaya* > *L. camara*. The results led to the conclusion that *Gliciridia sepium* exhibited the highest mortality, suggesting its potential for further study in the future.

Keywords: *Gliciridia sepium*; mortality rate of storage pests; plant extracts; rice weevil



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Effect of Pre-harvest Fruit Bagging on Yield and Quality of Pomegranate Fruits

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Pomegranate suffers massive pre- and post-harvest losses due to sun burning, fruit cracking and bird damage resulting in substantial yield losses. This study investigated the impact of pre-harvest fruit bagging, using various bagging materials, on both the yield and quality parameters of pomegranate fruits. Fruit bagging was done with white polythene bag (T1), black polythene bag (T2), silk cloth (T3), and paper bag (Double layer-inner cement paper and outer silver paper) (T4), and fruits without bagging was the control (T0). The research was conducted at the Agriculture Research Station, Kalpitiya. Five years old Kalpitiya hybrid pomegranate trees were selected for the study. Experiment was conducted as Randomized Complete Block Design (RCBD) with ten replicates for each treatment. Fruits were bagged after 15 d of fruit setting. Fruits were harvested 115 d of fruit setting for assessing yield and quality parameters. Bagged fruits showed higher yield performances compared to non- bagged fruits. Further, bagged fruits were totally free from bird damage, fruit cracking, and sunburn injury. The highest fruit weight (168 ± 14.57 g), length (68.88 ± 5.97 mm), and girth (225.12 ± 19.57 mm) were recorded in fruits covered with paper bag (T4). Additionally, T4 exhibited the most pronounced color development in both peel and aril. The maximum Brix value (16.4%) was recorded in both T1 and T4 bagging materials indicating enhanced sweetness. Consumer preference was notably higher for the fruits covered with paper bags (T4) during sensory evaluation. These results emphasized the significance of pre-harvest fruit bagging in improving pomegranate fruit quality and minimizing losses. Furthermore, the choice of bagging material plays a crucial role in determining the impact on fruit yield and quality. Based on the findings of this study, paper material (double-layered with inner cement paper and outer silver layer) is recommended as the most effective bagging material for enhancing pomegranate yield and quality.

Keywords: Bagging materials; cracking; pomegranate; pre-harvest; quality; yield



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Paper ID: NSALS24-026

Investigating the Effect of Different Coco-Peat Media and Electrical Conductivity Levels on Growth and Flowering of Potted Marigold (*Tagetes* sp.)

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Marigold (*Tagetes* sp.), which belongs to the Asteraceae family, is one of the most economically valuable ornamental crops grown globally. The *Discovery Mix F1* (*Tagetes erecta*) series is an African marigold variety that is popular as a potted plant in Sri Lanka at present. The main objective of this study was to identify a suitable coco-peat growing medium for the cultivation of marigolds. Low water holding capacity, abundance of pathogens, and weeds are some of the issues associated with traditional potting mixtures. Electrical conductivity (EC) serves as an index of salt concentration and an indicator of the electrolyte concentration of the solution. The study was carried out inside the plant house using ten treatments, namely T1: 100% coir pith/low EC, T2: 100% coir pith/medium EC, T3: 100% coir pith/high EC, T4: 75% coir pith+25% coir chips/low EC, T5: 75% coir pith+25% coir chips/medium EC, T6: 75% coir pith+25% coir chips/high EC, T7: 50% coir pith+50% coir chips/low EC, T8: 50% coir pith+50% coir chips/medium EC, T9: 50% coir pith+50% coir chips/high EC, and T10: Top soil: compost: burnt paddy husk in 1:1:1 high EC (control) (low EC: 500-800 $\mu\text{S}/\text{cm}$, medium EC: 800-1800 $\mu\text{S}/\text{cm}$, high EC: above 1800 $\mu\text{S}/\text{cm}$) in a Randomized Complete Block Design (RCBD) with three replicates in order to minimize the heterogeneous microclimates within the plant house. Plant growth, flowering, EC, and economical life span of the plants were measured and statistically analyzed. The results revealed that growing media had a significant effect on plant growth. T1, which recorded the highest mean values for plant height, canopy diameter, number of flowers per plant, flower diameter, overall appearance, and economical lifespan of the plants, can be considered the suitable growing media for potted Marigold production among the tested media. However, T7 showed the highest performance in terms of number of leaves and total dry weight. Therefore, T1 and T7 treatments performed well in the growth and reproductive growth of the plants; thus, these treatment combinations can be used to develop a new coco-peat growing medium for cultivating marigolds instead of using conventional potting mixtures.

Keywords: Coco-peat; electrical conductivity; potted plant; potting mixture



Study on Parasitic Fauna of Vegetable Leaf Miner (*Liriomyza sativae*) in Central Region of Sri Lanka

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Vegetable leaf miner, *Liriomyza sativae* (Diptera: Agromyzidae) is a worldwide insect pest causing severe yield loss and economic injury in many crops including tomato (*Solanum lycopersicum*) plants. Using chemical methods was inefficient and ineffective in controlling the field population of vegetable leaf miners. The exploitation of natural enemies has the potential to be used as biocontrol agents as a sustainable controlling method that can be incorporated into integrated pest management. The parasitoids can be used as biocontrol agents for vegetable leaf miners. This study was conducted to identify the parasitoid guild of vegetable leaf miner larvae in tomato fields of the Central Region from February to June 2023. Ten locations were selected from Kandy district and five locations were selected from Matale district. Leaf-miner-damaged leaves were collected from selected organically grown crop fields in the above-mentioned districts and placed in laboratory conditions (temperature at 25°C and relative humidity at 80%) for identification and analysis of parasitism levels of different locations. Three parasitoid guild species were collected from both districts, which belong to Hymenoptera: Eulophidae identified as *Neochrysocharis* spp., *Closterocerus* spp., and *Hemiptarsenus* spp. Identification of parasitoid species was done using taxonomic keys (wing, antenna, and leg modifications) and existing literature. The parasitism percentage was calculated using a formula given by Van Driesche. HORDI research field showed a higher percentage of parasitism of *Neochrysocharis* spp. (63.67%) in Kandy. In Pallepola area in Matale, *Hemiptarsenus* spp. (53.53%) showed higher parasitism level. However, the total percentage of parasitism, among species, *Neochrysocharis* spp. was higher in Kandy (23.38%) and Matale (22.08%) districts. *Hemiptarsenus* spp. and *Closterocerus* spp. showed low parasitism with 9.63% and 12.54% in Kandy and Matale, respectively. The intensity of parasitism varied from location to location and among parasitoid species. The study confirmed that the parasitoid species were more common in tomatoes in the Central Region of Sri Lanka. *Neochrysocharis* spp. was the most common species found in almost all locations in Kandy and Matale. *Neochrysocharis* spp., *Closterocerus* spp. and *Hemiptarsenus* spp. can be considered as potential parasitoid guild species for leafminer larvae for tomato crops.

Keywords: Biological control; leaf miners; level of parasitism; parasitoids



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Comparison of Major Nutrient Release Pattern of Pelleted Organic Fertilizer with Inorganic Fertilizer and Compost in Coconut Growing Soils

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Coconut cultivation relies on both organic and inorganic fertilizers as nutrient sources. However, one of the main challenges of using organic fertilizers is that they demand higher quantities to attain the same effectiveness as inorganic fertilizers. In organic fertilizer to simplify the application process in the field, pelleted organic fertilizers are made in various shapes, such as pencils and granule. The objective of the present study was to evaluate the major nutrients (nitrogen, phosphorus, potassium, and magnesium) release pattern of pelleted fertilizers in soil compared with inorganic fertilizers and compost. A pot experiment was conducted using Madampe soil series with five treatments: T1: Pencil pelleted organic fertilizer, T2: Granular pelleted organic fertilizer, T3: Compost, T4: Inorganic fertilizer-1, and T5: Inorganic fertilizer-2. All treatments were calculated based on the nitrogen content following the CRI recommendation. Daily irrigation was conducted. Soil pH, electrical conductivity and available major nutrients of soil were measured every 2-wk interval, and the total major nutrients of organic fertilizers were determined at the beginning of the experiment using standard methods. The findings indicated a notably greater nutrient release pattern in T2 compared to all other treatments ($P < 0.05$). When considering the lower and maximum availability of nutrients (mg/kg) after 6 wk, the nitrogen of T1 and T2 were 35.00 ± 2.45 and 177.50 ± 18.63 , respectively; the phosphorus of T1 and T2 were $193.7.00 \pm 99.00$ and 707.45 ± 174.10 , respectively; the potassium of T1 and T2 were 353.74 ± 85.70 and 499.04 ± 23.90 , respectively; and the magnesium of T1 and T2 were 76.10 ± 17.69 and 100.27 ± 11.66 , respectively. In conclusion, T1 is more suitable than T2 due to the slow release of nutrients and less bulkiness in using for the adult coconut cultivation.

Keywords: Compost; inorganic fertilizers; major nutrients; pelleted organic fertilizers



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Determination of Optimal Fertigation Level for Chilli Grown in Coir-Pith Medium

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Ensuring the sustainability of agriculture and food systems relies heavily on the effective management of water and nutrients. Green chilli (*Capsicum annuum* L.), which is widely cultivated in water-limited dry zones, is one of the economically important crops in Sri Lanka. There are less number of reports on optimum volumes of water and rates of fertilizers for drip-irrigated chilli grown in the coir-pith medium under protected house conditions. This study was aimed to develop an optimal fertigation level for chilli grown in a coir-pith medium. Three levels of irrigation with three levels of fertilization (T1: 50% of field capacity (FC) with N, P, and K at 81.74, 70.84, and 127.67 kg/ha; T2: 75% of FC with N, P, and K at 122.6, 106.3, and 191.6 kg/ha, and T3:100% of FC with N, P, and K at 163.5, 141.7, and 255.3 kg/ha) were applied to chilli (MICH HY1), and growth and yield parameters were measured. Soil moisture sensors were used to measure the moisture content of the growing medium and irrigation was conducted when the moisture level reached 80% depletion of FC. The study was designed with three treatments and 25 replicates for each treatment, and one-way ANOVA with a Randomized Complete Block Design was used to analyze the data. T3 exhibited a nominally higher dry matter yield, plant height, number of leaves, and pods compared to other treatments, but they were not significantly different. However, T1 demonstrated significantly higher water use efficiency (WUE) and nutrient utilization efficiency (NUE) than other treatments ($P < 0.05$). Hence, this study suggested that T1 is conducive to achieving better WUE and NUE. Further studies are recommended with factorial design to finetune the fertigation rates.

Keywords: Agronomic performances; chilli; fertigation; nutrient use efficiency; water use efficiency



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Paper ID: NSALS24-052

Development of a Compost using Green Manure Incorporated with Byproduct of Charcoal and Boiler Ash in the Activated Carbon Industry

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The activated carbon industry commonly uses coconut shells to produce activated carbon, valued for its unique properties, high quality and in abundance. The manufacturing process involves multiple steps, resulting in by-products such as charcoal, volatile organic compounds, tar and oils, and wastewater, contributing to substantial waste. Byproduct utilization is thus crucial to minimize this waste. This study was aimed to create an organic fertilizer using activated carbon industry byproducts incorporating green manure. By collecting minus charcoal and boiler ash as byproducts, four compost samples were prepared by altering the charcoal content as 0, 15, 30, and 50%. For increase the microbial activity and maintain the optimum nutritional value of the compost mixtures, glyricidia (nitrogen source) and Eppawala Rock Phosphate (phosphorous source) was added. Over a 2-month evaluation period at 2-wk intervals, the chemical composition of the compost samples was analyzed. The pH levels ranged from 7.1 to 7.9 over time. The fixed carbon content increased with the addition of charcoal to the mixtures. Nitrogen content exhibited a negative relationship with added charcoal and remained consistent over time. While phosphorus and potassium content showed no direct relationship with added charcoal and storage time, the 15% charcoal compost mixture demonstrated superior nutrient composition within the compost ($P < 0.05$). In conclusion, a 15% charcoal content showed a significant increase in nutrient composition while maintaining a suitable pH for plant growth. However, for specific industrial requirements, a 50% charcoal compost mixture can be utilized as compost.

Keywords: Charcoal; compost, nitrogen; organic fertilizer; pH; phosphorous



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Evaluation of Properties of Compost Made of Various Plant Materials and Animal Waste Available in Badulla District

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An experiment was conducted at the Uva Wellassa University to evaluate the physical and chemical properties of various compost products made of plant materials and animal wastes. Seven compost products comprised of three fresh products made of *Gliricidia sepium*, Kahakona (*Senna spectabilis*), and Acacia (*Acacia implexa*), a compost product made of waste plant materials collected from university premises, compost made of cow dung alone, poultry manure alone and a compost product available at the local market were evaluated. Three separate heaps were prepared to make each of *Gliricidia*, Kahakona, and Acacia based compost and each of them was supplemented with other organic materials and cow dung/goat manure. Chemical parameters such as nitrogen concentration and pH value of each compost were measured and remaining waste materials were analyzed using random samples of each compost product. Compost produced by Kahakona and *Gliricidia* exhibited substantially higher nitrogen levels, whereas compost derived from Acacia presented a balanced nitrogen profile reporting 0.124, 0.114, and 0.108%, respectively. The compost made using waste materials of the university reported the lowest nitrogen level of 0.087%. Cow dung compost (0.103%), poultry manure compost (0.103%), and market compost (0.1026%) showed comparable nitrogen levels. Market compost stood out with the highest pH value of 7.33 followed by University compost (7.31). Poultry manure and cow dung compost exhibited pH values of 7.09 and 6.90, respectively while composts made of Acacia, *Gliricidia*, and Kahakona plant materials reported lower pH values of 6.65, 5.93, and 5.87, respectively. University compost stood out with the highest amount of remaining undecomposed particles, weighing 782 g. In contrast, cow dung compost, poultry manure compost, and market compost exhibited relatively lower weights ranging from 446 to 622 g while *Gliricidia*, Kahakona, and Acacia plant composts ranged from the lowest values of 320 to 487 g. Compost products freshly made using the leguminous species of Kahakona and *Gliricidia* boosted with cow dung and goat manure slurry showed more promising characteristics having a fast decomposition rate of materials, favorably high nitrogen content coupled with a lower pH level falling within the range appropriate for crop growth.

Keywords: Compost; N content; pH; plant sources for compost making; residues in compost



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Paper ID: NSALS24-075

Evaluation of Tuber Qualities in Different Exotic Potato Varieties (*Solanum tuberosum* L.) in the Up-Country Intermediate Zone of Sri Lanka

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Popular value-added products are produced using potatoes, but the output is low due to limited production and lack of suitable varieties which have expected qualities. The current study was conducted at Regional Agriculture Research and Development Centre, Bandarawela to identify the tuber qualities of selected exotic potato varieties; Decibel, Naima, Najah, Topaze, Triplo, Galina, Yelda, Selena, and Brianna along with popular local variety; Granola, in Up Country Intermediate Zone. The field experiment was laid out in a Randomized Complete Block Design with three replicates. At the harvesting stage, the yield of each variety was collected separately and evaluated for tuber qualities. Parameters were checked before (tuber shape, skin color and flesh color of fresh tubers) and after boiling (flesh color of boiled tubers and cooking time). Additionally, sensory evaluation was done using a 5-point hedonic scale with the participation of 30 untrained panelists for selecting better variety according to the preference based on color, taste, aroma, starchy taste, firmness, mouth feeling as well as overall taste and preference. The variations among varieties were observed with tuber shape, peel color, and flesh color of the fresh and boiled tubers. Based on the statistical analysis of parametric data, there was a significant variation in Brix value (ranged between 3-5 °Bx) and cooking time (ranged between 40-70 min) among tested potato varieties ($P < 0.05$). Topaze was the most preferable variety according to the sensory evaluation. Variety Brianna, Najah, and Triplo were also scored for all attributes when compared to Granola. However, as tuber shape and Brix value are important factors for processing purposes, there is a potential to use variety Brianna for the production of potato chips as it has round shape and varieties Naima, Najah, and Galina for the production of french fries as they have long oval shape. Variety Najah can be selected for processing as it has the lowest Brix value (3.93 ± 0.07 °Bx). In conclusion, different potato varieties have unique and consumer favorable tuber qualities. According to the necessity, the user can select the best variety for the required purpose.

Keywords: Exotic varieties; potato, sensory evaluation; tuber quality; up-country intermediate zone



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Paper ID: NSALS24-108

Evaluation of the Above and Below Ground Biomass Accumulation of Selected Tea (*Camellia sinensis* L.) Cultivars Grown on Conventional and Coco-pith-Based Nursery Media

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Tea (*Camellia sinensis* L.) is an evergreen, woody, perennial, plantation crop that significantly contributes to the economy of major tea-growing countries. The biomass accumulation of the shoot and roots significantly influences the success of the tea nursery. Chlorophyll content based on greenness value (SPAD) is also a good indicator of the photosynthesis activity of the tea plant. Proper root growth reduces mortality and enhances the tolerance to moisture stress when planted in the field. Cultivar-specific poor root formation is one of the major drawbacks in soil potting medium. Therefore, this study was conducted to evaluate the above- and below-ground growth performances and chlorophyll content of selected tea cultivars under conventional (soil) and new coco pith-based potting media. Two hundred and fifty cuttings of TRI 3072, TRI 4052, TRI 4053, TRI 4071, and TRI 5002 cultivars were assigned for each treatment. The Completely Randomized Design (CRD) was used as an experimental design. The chlorophyll content, shoot dry weight, media length-to-root length ratio (MLRLR), and media volume-to-root dry weight ratio (MVRWR) were measured in randomly selected 10 plants from each cultivar at 57, 71, 85, 99, 113, 127, 141, and 155 d after planting. The data were analyzed using Minitab 17 statistical software. According to the analyzed SPAD value, only TRI 5002 cultivar reported a significantly higher ($P < 0.05$) SPAD value under coco pith medium. TRI 5002 exhibited a low MLRLR and MVRWR in soil but it showed a significantly higher ($P < 0.05$) MLRLR and MVRWR on coco pith media. TRI 3072 cultivar reported a significantly higher MVRWR on soil media ($P < 0.05$) and the other three cultivars reported no significant differences between the two media. According to the results of below ground growth analysis, all the above-mentioned cultivars including poor rooting TRI 5002 showed significantly higher MLRLR and MVRWR on coco pith medium ($P < 0.05$). Enhanced rooting ability and conducive physical properties were observed in the coco-pith-based new potting media. These findings indicated that coco-pith has a high potential as an alternative medium for tea nurseries.

Keywords: Coco pith; potting media; rooting; shooting; tea cultivars; vegetative propagation



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Development of Propagation Protocol: *Syzygium zeylanicum*, A Potential Landscape Plant

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Interest in native plants for landscaping is increasing and nursery growers need to expand the production by adding new native species. In landscape industry, plants are widely used for beautification and for functional purposes. Currently, a large number of exotic plants are being used for landscaping, even though the potential is with native plants that could be introduced to the industry. Considering the hindrance of seed propagation and lack of successful propagation techniques for commercialization, this research was aimed to develop a successful propagation protocol for *Syzygium zeylanicum* (Yakada maran) which would be introduced as a landscape plant. In this propagation study softwood and semi-hardwood cuttings were treated with two different plant hormones at a rate of 8,000 ppm (IBA and IAA) along with non-treated control and established in sand:coir dust (1:1), sand:coirdust:topsoil (1:1:1) media, respectively. The experiment was carried out in Factorial Completely Randomized Design (CRD) with 10 replicates comprising 12 treatment combinations inside a propagator in a net house. Number of shoots, number of roots, and survival percentage were recorded in 3 months after planting. The interaction effect of cutting type, potting media, and hormone type was significant on number of shoots and roots ($P < 0.05$), but not on survival percentage. The highest shooting of cuttings was observed by softwood cuttings in sand mix coir dust 1:1 medium. The best average number of well-developed quality roots along with moderate shooting performances were observed in semi-hardwood cuttings in the sand, coir dust and soil mix medium supplemented with IAA hormone. Therefore, *Syzygium zeylanicum* can be propagated successfully using semi-hard wood cuttings in the sand, coir dust and soil mix medium with IAA hormone for commercial propagation.

Keywords: Landscape; native; propagation; rooting; shooting

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Paper ID: NSALS24-006

Design of Flexible Green Anti-Radiation Shielding Material by *Dracaena trifasciata* for Mobile Phone Radiation.

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Radiation exposure, especially from mobile phones, poses health risks, necessitating effective shielding materials. Traditional materials like lead have limitations in flexibility and eco-friendliness. This study involved utilizing *Dracaena trifasciata*, or the Snake plant, to develop a flexible and environmentally friendly anti-radiation shielding material for mobile phones, with an emphasis on evaluating its radiation attenuation properties, flexibility, and sustainability. The procedure entailed extracting the liquid from *Dracaena* leaves, mixing it with polyvinyl acetate (PVA), glycerol, and agar, and improving the formulation. Adjusting the ratios of the mixture revealed that a 4:3:5:100 ratio of agar:glycerol:PVA:*Dracaena* liquid was the optimal combination for the shielding material, allowing the formation of a thin film without any issues. Within the temperature range of 20°C to 100°C, the material efficiently forms at 45°C without compromising its structural integrity. The average thickness of the material was 3.0 mm. Current popular cell phone brands have undergone radiation testing performed by a dosimeter. E-field emissions decreased significantly with the *Dracaena* thin film (62% reduction) and even further with *Dracaena* jelly (77% reduction). Thermal absorption, water absorption, mechanical characteristics, and surface morphology of the designed material were investigated. *Dracaena* thin film efficiently mitigated temperature differentials on smartphones with an average temperature drop of 3.6°C. It exhibited competitive tensile strength (1.8 MPa for its maximum load threshold) and strain (0.32 at maximum load) characteristics. In the water absorption test, it attained its maximum weight gain of 64% within 4 h. SEM analysis revealed surface irregularities in the thin film, indicating the need for improved surface quality.

Keywords: Eco-friendliness; radiation exposure; snake plant; sustainability; thin film



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Paper ID: NSALS24-008

Analysis of Drought Adaptation Strategies: A Case Study in Polpithigama DS Division, Kurunegala

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Drought can be defined as a natural disaster which poses significant impacts on environment, social and economic aspects. As this disaster is a major issue in the 21st century, it poses large scale issues in humans in every perspective. In Sri Lankan context this situation has increased in the present period especially in the dry zone to a greater extent. With this background, this study was based on an analysis of human perception of drought adaptation strategies from Polpithigama DS Division, Kurunegala. The objectives of this study were to identify drought, drought types, drought impacts and drought adaptation strategies in the study area. A questionnaire survey and field observation were used to collect data. In the survey, focus group technique was used and livelihoods were especially selected for the sample. Results of the survey revealed that most livelihoods have a good understanding of drought and its types including the impacts and identified drought as a natural disaster (82%). Further, 18% of livelihoods stated that drought is a man-made disaster. The survey revealed that the hydrological drought is the most common drought (41%) and livelihoods used drought adaptation strategies to reduce the environment, social and economic impacts of drought. The most common environmental changes were less water security (54%), loss of soil quality (15%), dry vegetation (53%), changes in the air composition (19%), and pasture degradation (26%). The economic changes were less income (41%), less savings (14%), difficulty to be employed (10%), disruption of agriculture (33%), and other (2%). The social changes were less of food security (22%), health issues (26%), water related conflicts (27%), malnutrition (19%), and other (7%). The strategies were rainwater harvesting (10%), Chena cultivation (14%), Bethma cultivation (37%), growing less water consuming crops (7%), store harvest (12%), using traditional irrigation practices (7%), and agro well usage (13%). In addition, implementing integrated water source management, implementing agroforestry and policies and organizing awareness campaigns can be used to reduce the drought impact and increase human perception of drought adaptation strategies.

Keywords: Adaptation; bethma; drought; livelihoods; perception



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Paper ID: NSALS24-020

Removal of Heavy Metals from Wastewater using Mycofilter with Activated Carbon

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Industrialization and increasing population are considered as the roots of heavy metal pollution of water. Many physical and chemical methods are currently being used to remove heavy metals from water, which are expensive and not environmentally friendly. Since white rot fungi have been identified as an organism with effective heavy metal removal capability and activated carbon, which is identified as an excellent absorbent, the present study focused on the preparation of a mycofilter made with both which is a less expensive, environmentally friendly, innovative method to remove heavy metals from polluted waters. White rot fungi tentatively identified as *Daedaleopsis confragosa* was collected from the Uva Wellassa University premises. They were cultured in the laboratory on potato dextrose agar (PDA) and were identified using morphological and colony characteristics. A filtration unit was prepared using activated carbon, wet straws, woodchips, and the selected fungal species. The heavy metal solution of 5 ppm was prepared using salts of Chromium (III) Chloride ($\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$), Copper (II) chloride ($\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$), Nickel (II) chloride ($\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$), Lead (II) nitrate [$\text{Pb}(\text{NO}_3)_2$] and Iron (III) chloride (FeCl_3). The filtrates were analyzed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The mycofiltration unit efficiently removed Cd (II), Cr (III), Pb (II), Ni (II), and Fe (III) during the first hour at a filtration rate of 0.105 mL/s, with removal efficiency rates ranging from 72.11% to 97.45%. In the second hour at a filtration rate of 0.076 mL/s, removal efficiency rates were nearly 100% for Cd (II), Cr (III), and Ni (II). The third hour at a filtration rate of 0.050 mL/s showed removal efficiencies ranging from 43.65% to 97.6%. All target heavy metal ions were removed more efficiently when the retention time gets increased. However, additional factors and further investigations should be essentially conducted to recognize the performance and behavior of the mycofilter under different conditions over longer continuity. As conclusion, Ni (II), Cd (II), and Cr (III) were effectively removed, while Fe (III) and Pb (II) exhibited comparatively lower removal rates.

Keywords: Activated carbon; ecofriendly; heavy metal removal; mycofiltration; wastewater treatment



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Paper ID: NSALS24-030

A Preliminary Analysis of Environmental Quality in Selected Locations in the Southern Coast of Sri Lanka Using Marine Polychaetes and the AZTI's Marine Biotic Index

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The southern coastal region of Sri Lanka is vital for diverse and valuable marine ecosystems but also faces various environmental threats from human activities. To assess the impact of these disturbances, we conducted a preliminary study using marine polychaetes as bioindicators and the AZTI's marine biotic index (AMBI) as a tool. We chose Unawatuna coral beach, Galle harbor, and Gin river mouth, which were exposed to different kinds of human disturbances, such as industrial effluents, sewage disposal, and oil spills. Marine benthic sediment samples were collected at each location using an Ekman grab sampler along the line transect sampling method, with a distance of 10 m between each sample up to 100 m from the shoreline. The polychaetes in the samples were classified up to the family level, and their AMBI values were calculated and contrasted with the reference values for the ecological quality status. We found that the three sites we studied; Unawatuna coral beach, Galle harbor, and Gin river mouth were moderately disturbed as indicated by mean AMBI values of 4.57, 4.25, and 4.00, respectively. The polychaetes diversity of Unawatuna coral beach was unbalanced, with a high proportion of polychaete families that can tolerate pollution (73.70% in EG III and 21.10% in EG IV). Although Galle harbor had mostly sensitive families (59.7% in EG I), there was also a significant number of families that indicated unbalanced conditions (19.4% in EG IV and 7.8% in EG V). Gin river mouth had a noticeable presence of families that were tolerant and opportunistic (16.70% in EG III-V). Our findings indicated moderate disturbance across study sites. Unawatuna coral beach exhibited an unbalanced ecosystem, possibly influenced by anthropogenic inputs, including intensive tourism and the discharge of sewage from hotels into the sea. Galle harbor faces challenges from oil spills and harbor-related activities. In Gin river mouth, the presence of tolerant families suggests varied human impacts, including pipeline discharges, riverine inputs, non-point source runoff, waste disposal, sedimentation, and erosion. Overall, our study, utilizing polychaetes and the AMBI index, emphasized the necessity for conservation measures. In future research, a priority should be placed on exploring specific sources of pollutants for targeted conservation and sustainable management.

Keywords: AZTI's marine biotic index (AMBI); environmental impacts; marine polychaetes; Southern coast of Sri Lanka



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Paper ID: NSALS24-033

Floral Diversity of Coastal Vegetation in Matara, Sri Lanka

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Sri Lanka's coastline spans over a length of approximately 1620 km, encompassing diverse habitats. Coastal floral diversity plays an important role in maintaining ecosystem productivity, stability, sustainability and other ecosystem services that are essential for humans. Mangroves, wetlands, coral reefs, marshes, seagrass, estuaries, bays and sand dunes are the main ecosystems found in coastal regions. The vegetation of coastal areas in Sri Lanka remains relatively understudied and scarce. Thus, this study was conducted to investigate and unveil the species diversity present in the coastal region of Matara district. The study was done from February to June 2023. Randomly selected 12 sites from the Matara district coastal area and each site was surveyed using 3 belt transects (5 m × 50 m) which were laid perpendicular to the shoreline and cross the water-land gradient. A total of 36 belt transects were used and floral species in each transect were identified and counted. Three different types of ecological zonation were also identified in the study site from seaward to landward gradient those are primary vegetation mainly creepers, secondary vegetation mainly shrubs, and tertiary vegetation taller shrubs and trees. A total of 125 species belonging to 41 families and 109 genera were recorded. *Digitaria ciliaris* (22%) of the Poaceae was the most abundant species in the study area. The Shannon diversity index (H), Shannon Evenness (E), and species richness were calculated for each site and data analysis was done with MS Excel 2010 version. The highest Shannon diversity index (H= 1.31) was recorded at sites 9 and 11. The lowest Shannon diversity index (H= 0.77) was recorded at site 4. The highest species richness and Shannon Evenness were recorded at site 7 and site 11, respectively. A few studies have been carried out on coastal vegetation diversity. This study explored coastal vegetation by investigating the floral diversity along the coastline. The research focused on understanding the ecological importance and influences of these coastal plants, aiming to fill a gap in existing knowledge. Further studies are needed to understand the ecological aspects of coastal vegetation as these coastal ecosystems have not been studied for years.

Keywords: Coastal vegetation; diversity index; floral diversity; Matara; Sri Lanka



The Impacts of Marine Heatwaves on Surface Productivity and Upwelling Rates of the Somali Upwelling Current in the Indian Ocean

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Marine heat waves (MHWs) are extended and pronounced episodes of unusually warm water lasting more than five consecutive days. MHWs are becoming more frequent worldwide and are predicted to intensify and become more frequent due to human-induced climate change. These anomalous warm water events have far-reaching impacts on primary productivity in marine ecosystems, wildlife, and human activities. The primary productivity (PP) in the Arabian Sea is greater than that of the Bay of Bengal in the Indian Ocean (IO) due to the intense upwelling of the Somali upwelling current. However, there are few scientific studies on MHWs in the Somali upwelling region of the IO. This study investigated the characteristics of MHWs, the relationship between climate modes and the occurrence of MHWs, and the impact of MHWs on PP from 1982 to 2022 in the Somali upwelling region in the IO. For this purpose, high-resolution satellite-based sea surface temperature (SST) data from the National Oceanic and Atmospheric Administration (NOAA) from 1982 to 2022 were used. The difference in SST within the continental shelf, perpendicular to the coastline, was considered to identify the upwelling areas. The results showed that MHWs were more frequent and intense in 1998 and in the last decade of the study period. The temporal trend of the monthly sea surface temperature anomaly (SSTA) in the Somali upwelling region between 1982 and 2022 was about $-0.13 \pm 0.064^\circ\text{C}/\text{decade}$. The frequency of MHWs in our study area was consistent with the positive phases of NINO 3.4 and the IOD climate modes, such that the years with positive phases of these modes were the years of the highest occurrence of MHWs in our study region. High SSTA and the upwelling index showed an inverse relationship throughout the study period, which was even more pronounced in the last decade (2012-2022) of the study period. High SSTA and low upwelling rate decreased chlorophyll concentration in the area, indicating low PP. Therefore, further scientific studies on the impact of MHWs on upwelling rate, including monsoon wind patterns, are recommended to determine the impact on the environment and economy of the coastal states.

Keywords: Chlorophyll-a; NINO (3.4); northwest Indian ocean; sea surface temperature anomaly; upwelling index.



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Spatial Variation of Macroinvertebrates Diversity in the Upper Catchment of Kumbukkan Oya, Sri Lanka

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Freshwater streams are supreme habitats for different faunal assemblages. The level of abundance and diversity of macroinvertebrates are widely used as stream habitat health indicators since their variable sensitivity towards different stream catchment alterations, hence this study was conducted to assess the spatial variation of composition and diversity of macroinvertebrates in the upper catchment of Kumbukkan Oya. The study was conducted from April to June 2023 and four stream locations were selected according to anthropogenic activities, respectively from upper region to lower region: relatively pristine site (S_1), gem mining area (S_2), high agricultural practices area (S_3), and relatively urbanized and agricultural area (S_4). A total of 201 macroinvertebrates were collected and 18 Families distributed within 09 Orders were identified according to the standard manual. The highest species density of macroinvertebrates was recorded from the high agricultural practices area (S_3) as 72 individuals and the lowest recorded from the gem mining area (S_2) as 14 individuals. Most pollution-sensitive, *i.e.* zero tolerance level Odontoceridae, and tolerance level one Perlidae, Brachycentridae taxa were only found in the relatively pristine site. The high abundance of higher tolerance macroinvertebrate families such as Simuliidae, Coenagrionidae, Physidae, Chironomidae, Caenidae, and Psephenidae were found in S_3 and S_4 sites. The macroinvertebrates composition was analyzed using Shannon Wiener diversity index (SWDI). The highest SWDI for macroinvertebrates was recorded as 1.88 ± 0.21 in a relatively pristine site (S_1) and the lowest was recorded as 0.50 ± 0.58 in gem mining area (S_2). There was a significant difference in SWDI among the four study sites ($P < 0.05$). These findings concluded that the significant differences in macroinvertebrate diversity in the study area of Kumbukkan Oya river could be caused by anthropogenic activities which directly affected to habitat degradation and pollution aggregation. Therefore, frequent habitat health assessments and control of anthropogenic effects in the catchment are important.

Keywords: Bioindicator; Kumbukkan Oya; macroinvertebrates diversity; Shannon Wiener diversity index (SWDI)



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Investigation of Sea Surface Temperature Fluctuation Over Shallow Coral Reef Ecosystems in Oman, CRW Muscat Site, For the Period of 1998–2022

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Coral reefs globally serve as hotspots for biodiversity. In recent years, one of the major threats of fluctuations in sea surface temperature has created additional pressure on reefs that could endanger sensitive ocean coral reefs. Rapid fluctuations in sea surface temperatures have led to a significant rise in mass coral bleaching occurrences and the associated death of reefs since most corals are thermally sensitive. Therefore, this study was designed to investigate the fluctuation of inter-annual and intra-annual sea surface temperature from 1998 to 2022 over the most prominent coral reef in Oman, the CRW Muscat site coral reef. The data was gathered using the Coral Health and Monitoring Program Portal online database, which provides daily data from the fixed sea surface temperature sensor of the relevant reef. There was an annual average sea surface temperature trend increasing by 0.01°C per year. The maximum and minimum monthly average sea surface temperatures were recorded in June (31.88°C) and February (23.83°C), respectively. The maximum and minimum annual average sea surface temperatures were recorded in 2022 (28.78°C) and 2003 (28.05°C), respectively. The maximum annual positive and negative anomaly sea surface temperatures were recorded in 2022 (0.36°C) and 2003 (-0.37°C), respectively. Comparatively, high positive annual anomalies were recorded in 1998 (0.15°C), 1999 (0.05°C), 2001 (0.04°C), 2002 (0.06°C), 2005 (0.10°C), 2010 (0.17°C), 2015 (0.32°C), 2016 (0.03°C), 2017 (0.20°C), 2018 (0.12°C), 2020 (0.09°C), 2021 (0.20°C), and 2022 (0.36°C). Comparatively high negative annual anomalies were recorded in 2000 (-0.49 °C), 2003 (-0.37°C), 2004 (-0.16°C), 2006 (-0.01°C), 2007 (-0.20°C), 2008 (-0.26°C), 2009 (-0.02°C), 2011 (-0.18°C), 2013 (-0.28°C), 2014 (-0.22°C), and 2019 (-0.04°C). Global warming and climate change have an impact on this region's regular pattern of variations in sea surface temperature. As a result, thermal stress on coral reefs may occur, which could induce coral bleaching and negatively impact the ecosystem's health. This study will help with the purpose of researching coral mortality and conservation at this site.

Keywords: Anomaly; coral reef; Oman CRW Muscat site; sea surface temperature



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Spatial and Temporal Variation on Night Light Pollution in the Turtle Nesting Sites in the Southern Coastal Area, Sri Lanka

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Artificial light at night (ALAN) has emerged as a global environmental concern, in parallel to rapid urbanization and coastal development, leading to heightened light pollution. This disruption of natural day-night cycles profoundly affects various wildlife species, especially marine turtles, which rely on visual cues for their navigation. The Southern coastal regions of Sri Lanka are vital nesting sites for diverse marine turtle species, facing threats including night light pollution. This study aimed to explore spatial and temporal trends of night light pollution in these critical habitats, utilizing satellite imagery. Study areas were selected based on documented pre-existing research and records. Nighttime satellite imagery from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB) at 500 m resolution was obtained for January 2018 to January 2023 and analyzed in Google Earth Engine to examine monthly trends in median radiance. Field surveys using questionnaires were conducted with 426 respondents to determine ground conditions and community perspectives on light pollution impacts pinpointing potential threats to turtles. The night light pollution emerged as a significant threat, exhibiting the increment of intensities across regions. Mirissa displayed higher radiance fluctuations, reaching peak levels beyond eight, in contrast to Rekawa and Marakoliya with lower radiance around an average radiance of one. An interesting consistency across all regions was the observation of peak radiance during December; potentially linked to elevated tourism activities, a finding consistent with the data collected through the questionnaire. Based on the field survey, over 50% of sightings occurred in the first quarter of the year, between January and March, emphasizing the significance of the first quarter of the year for turtle reproductive activities. Recommendations to mitigate night light pollution on turtle species include adopting low-intensity lighting, utilizing energy-efficient sources, implementing proper shielding, prioritizing amber or long-wavelength lights, and focusing on critical nesting sites. Collaborative efforts to develop conservation strategies with stakeholders, authorities and communities are vital to safeguard these magnificent creatures and their delicate ecosystems.

Keywords: Coastal conservation; marine turtles; night light pollution; southern coast; spatial data

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Paper ID: NSALS24-003

Development of Milk-Grain Food Supplement and Determination of the Trypsin Inhibitory Factor and Texture Profile Analysis

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Breakfast holds pivotal significance as it replenishes essential nutrients after a night of fasting, fostering a healthy start to the day. Unfortunately, the prevalence of breakfast skipping, regardless of age, raises concerns about potential health issues. Whole grains, rich in nutrition, offer an ideal breakfast component, yet their unpalatable nature, marked by flatulence, hampers widespread acceptance. Objective of this study was to develop a ready-to-eat milk-multigrain food supplement for breakfast while avoiding the unpalatable nature of the whole grains. The multigrain mixture contained 45% red rice, 25% red cowpea, 20% barley, and 10% sesame. The two best formula of 35% and 40% food supplements were selected based on a sensory evaluation done by 15 trained panelists. The precooked multigrain mixture was wet blended with UHT milk and sugar (8%). The amounts of grain mixture and milk were 35% and 57%, and 40% and 52% in 35% and 40% food supplements, respectively. The products were pasteurized at 90-95°C for 30 min. Trypsin inhibitory activity (TIA), hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness, pH, and water activity of the products were measured following the standard methods. The products were subjected to total plate count, yeast and mold count, and coliform tests. Titratable acidity and sensory properties of the products were evaluated at 1st, 5th, 7th, and 10th d of storage. Data were subjected to one-way ANOVA with 95% level of significance. There was a significant difference in TIA between the two products ($P < 0.05$) and 40% food supplement had the lowest trypsin inhibitory activity (0.34 ± 0.00 mg/g) compared to the 35% food supplement (0.40 ± 0.00 mg/g). Food supplements incorporated with 35% and 40% grain content had hardness (1825 g, 1920 g) at cycle 1, adhesiveness (108.66 mJ, 110.1 mJ), springiness (30.28 mm, 25.32 mm), cohesiveness (0.43, 0.36), gumminess (779.8 g, 687.3 g), and chewiness (231.56 mJ, 170.65 mJ), respectively. Adhesiveness and cohesiveness were slightly similar in two products than the other parameters. According to the microbiological and chemical tests, both food supplements had 10 d of shelf life. Through the processing, TIA of the whole grain had been decreased than the raw grains and 35% food supplement was more acceptable than the 40% food supplement with respect to TIA and textural properties.


Keywords: Food supplement; multigrain; texture profile; trypsin inhibitory factor



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A Comparative Study on Quality parameters of Milk; Based on Selected Milk Collection Centers in Uva Province of Sri Lanka

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Cow's milk is recognized as a vital and incredibly nourishing food for consumers. The practices of dairy producers are still greatly influenced by the quality of the raw milk as it is based on the chemical components present in raw milk. The dairy sector in industrialized nations uses simple, standardized testing processes to assess milk quality. Furthermore, within the context of Sri Lanka, databases for monitoring milk quality are not kept at least on regional basis. Therefore, this study aimed to identify relationships among the quality parameters of raw milk in selected areas of the Uva Province of Sri Lanka. The selected quality parameters were fat, solid non-fat, lactose, protein, added water, freezing point, corrected lactometer reading, pH, Keeping Quality (KQ), solubility index and presence of alcohol, which were observed to identify the quality status of raw milk that were received from different collecting centers situated in selected areas. Identifying the quality of raw milk according to the area received, helps to provide the best quality raw milk for the production that complies with their standards. Ultrasonic milk analyzer, pH meter, alcohol test, and resazurin dye reduction test were used for the analysis of milk samples. Quality status was determined among the raw milk samples by mean comparison and the process control charts. Analytical results revealed that the mean values of milk quality parameters in Uva Province were 6.33±0.25 (pH), 4.09±0.23% (fat), 7.87±0.39% (solid non-fat), 3.20±0.19% (protein), 4.70±0.25% (lactose), 25.48±0.08 (corrected lactometer reading), 0.10±0.51% (added water), 0.54±0.03°C (freezing point), 0.70±0.04 mg/L (solubility index) and 3.00±0.01 (Keeping Quality). In addition, 66% of the milk samples showed negative results for alcohol test. Milk samples collected from Walugolla, Koonketiya, Handapanagala, Meeriyabadda, and Girandurukotte showed greater milk quality according to the standards.

Keywords: Comparative study; milk collection; quality parameters; ultrasonic milk analyzer; Uva Province



Quality Evaluation and Storage Studies of Protein-Enriched Cake Incorporated with Button Mushroom (*Agaricus bisporus*) Powder

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Edible mushrooms are widely used in human foods. It has good texture, flavour as well as some nutritional and medicinal value. Mushrooms have a short shelf life of about 24 h at the ambient conditions due to high moisture, delicate texture, and unique physiology. Mushroom powder-added cake is a value-added product and mostly suitable for any age groups. This study was conducted to assess the quality attributes and shelf life of cake incorporated with dried button mushrooms (*Agaricus bisporus*) powder. Cakes were prepared by using different ratios of wheat to mushroom powder such as 100:00 (T₁; Control), 95:05 (T₂), 90:10 (T₃), 85:15 (T₄), and 80:20 (T₅). The quality characteristics and microbial safety of the cakes were assessed at weekly interval during 4 wk of storage. The physicochemical characteristics such as fat, protein, ash, moisture, and soluble carbohydrates of the formulated cakes were analysed using standard methods. Organoleptic evaluation of the cakes was performed by 30 trained members to assess the attributes including colour, texture, appearance, taste, aroma, mouth feel, and overall acceptability using 7-point hedonic scale. The results were analysed statistically by ANOVA using SPSS at 95% level of significance. Based on the quality attributes and overall acceptability, T₁, T₃, T₄, and T₅ were selected for storage studies. These developed cakes were packed and sealed in aluminium foil-based laminate packaging material which is used commercially. The cake samples were stored under ambient conditions (30±1°C and 75-80% RH). In T₄ treatment, the moisture content increased from 21.80±0.45 to 24.65±0.95% and ash, protein, fat, and total soluble carbohydrate contents decreased from 0.42±0.01 to 0.34±0.01%, 6.73±0.10 to 6.65±0.13%, 16.23±0.28 to 15.21±0.26%, and 42.44±1.05 to 40.75±1.02% at the end of 3-wk storage period, respectively. No microbial growth was observed during the storage period. The results of this study revealed that the protein-enriched cake made with 85% wheat flour and 15% mushroom powder could be stored for 3 wk in ambient conditions without significant changes in the quality attributes.

Keywords: Button mushroom; protein-enriched cake; quality attributes; shelf life



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Consumer Preference of Defatted Coconut Flour Incorporated Sandwich Bread: A Case Study in North Western and Western Province of Sri Lanka

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Wheat flour, which is a poor source of dietary fiber is the main ingredient used to prepare bread. Consumption of food with high fiber is very essential for minimizing the risk of non-communicable diseases. Defatted coconut flour, which is a byproduct of virgin coconut oil manufacturing processes, is a rich source of dietary fiber. In this context, the Coconut Research Institute has developed a sandwich bread replacing 15% of wheat flour with defatted coconut flour. This study was conducted to evaluate the consumer preference for defatted coconut flour incorporated sandwich bread. A total of 300 consumers were selected randomly representing males, females and all the age groups, on a prorated basis considering the population of each district of the Western and North Western provinces of Sri Lanka. Samples of sandwich bread prepared with and without the incorporation of defatted coconut flour were served to the respondents, and their preferences for color, taste, aroma, texture, and overall acceptance were evaluated using a pretested structured questionnaire. Data were descriptively analyzed using MS Excel and STATA software. The sample population comprised of 55% female and 45% male. Further, with respect to the age groups (years), out of the 300 respondents, 6 (2%) were below 20, 43 (14%) were between 20 and 25, 125 (42%) were between 25 and 45, 67 (22%) were between 45 and 55, and 59 (20%) were above 55. As per the ordinal logistic regression model, there were no significant correlations between the preferences for the sensory properties of bread and the demographic characteristics. Concerning the taste, color, aroma, texture, and overall acceptability, about 76, 76, 81, 69, and 79% of the respondents preferred the defatted coconut flour incorporated sandwich bread, respectively whereas, 23, 23, 18, 27, and 20% of respondents were indifferent with respect to those properties of the bread samples. Further, 99% of the respondents expressed their willingness to buy the defatted coconut flour incorporated sandwich bread. It can be concluded that there was a great consumer preference for the newly developed defatted coconut flour incorporated sandwich bread.

Keywords: Consumer preference; defatted coconut flour; North Western province; sandwich bread; Western province

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Effect of the Brine Concentration on Quality Characteristics of Sauerkraut

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A naturally fermented cabbage product called sauerkraut is one of the food products preserved by fermentation. Sauerkraut production mainly depends on a sequential microbial process that involves heterofermentative and homofermentative lactic acid bacteria. Sauerkraut contains a lot of nutrients such as vitamin A, C, and K and certain minerals like Fe, Mn, and Cu. Products made from fermented vegetables are tasty, healthy, and microbiologically safe. Sauerkraut may easily be kept for a long time without refrigeration. The most important role of fermentation is that it helps to make the nutrients naturally found in the starting food materials, more widely available than would be possible without fermentation. Further, during cooking, vitamin C which is an important nutrient of cabbage is destroyed if not processed properly. Therefore, vitamin C and other nutrients can be preserved through fermentation in sauerkraut. Cabbage and similar types of vegetables have relatively higher fermentability than other vegetables as they have more fermentable sugars. Previous studies have indicated that most of the Sri Lankans dislike the unpleasant flavor of sauerkraut. The aim of this study was to make sauerkraut from white cabbage (*Brassica oleracea* var. capitata) produced in Sri Lanka using different brine concentrations and to measure the factors which determine the nutritional composition of sauerkraut. Shredded cabbage was separately fermented for 7 d at various brine concentrations (2, 2.5, and 3%). Physicochemical parameters were evaluated using standard methods. The parameters were measured daily for seven days of fermentation. The sauerkraut was analyzed in terms of pH, total soluble solids (TSS), moisture content, lactic acid percentage, reducing sugar, and vitamin C during fermentation. According to the results, the reducing sugar content in 2.5% brine concentration was found to decrease from 2.66 to 1.56% during 7 d of fermentation. Lactic acid content was higher (1.5%) in 2.5% brine concentration on the 7th d of fermentation. The TSS increased (8.6%) at 2.5% brine concentration due to the activity of lactic acid bacteria. The vitamin C content reached its maximum value (20.79 mg/100 g) at 2.5% brine concentration during 7 d of fermentation and slightly decreased thereafter, which is due to the degradation during fermentation. The pH of sauerkraut decreased during the fermentation and decreasing rate declined as the brine concentration was increased. The pH reached 3.3 when the brine concentration was 3%. The moisture content ranged between 82% and 84% in all three brine concentrations. The sample which was fermented at 2.5% brine concentration showed the best results. The results obtained in other brine concentrations are not favorable. Thus, by utilizing appropriate brine concentrations, the quality characteristics of sauerkraut can be increased. Sauerkraut can be used as an additional food source because of its nutritional qualities. As it is a very good source of lactic acid and have higher digestibility, it is an ideal supplement for people who are suffering from lactose intolerance.

Keywords: Cabbage; fermentation; lactic acid; sauerkraut



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Development of Value-added Spicy Butter through the Addition of Hot Pepper (*Capsicum chinense*) Powder

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Butter is a high-fat dairy product made by churning either fresh fermented cream or milk. The quality of butter deteriorates due to rancidity development and microbial spoilage. Microbial and oxidative rancidity can be effectively controlled by adding antioxidant and antimicrobial substances. Hot pepper (*Capsicum chinense*) is known to be an excellent source of phytochemicals which may exhibit antimicrobial and antioxidant activities. This study aimed to examine the effects of natural antioxidants from hot pepper on the reduction of oxidative rancidity in salted butter. Green hot pepper (GHP) and red hot pepper (RHP) powders were prepared by oven drying at 50°C for 24 h until the moisture content reached less than 10% of dry basis and milling to a fine powder. After that, butter was prepared by incorporating GHP and RHP powders at 1% and 2% (w/w) concentrations separately at the end of the churning process. Butter without adding the hot pepper powder was used as the control. Dehydrated hot pepper powder and prepared butter were analyzed for total phenolic content (Folin-Ciocalteu method), total flavonoid content (TFC; aluminium chloride method), and radical scavenging activity (DPPH method). Changes in peroxide value, free fatty acid value, and pH were monitored at weekly intervals. Samples were also analyzed for total plate count, and yeast and mold count at weekly intervals for one month storage period. Radical scavenging activity (RSA) of RHP (75.95±0.27%) and GHP (66.99±0.45%) powders displayed significant differences. Total phenolic content (TPC) of RHP and GHP powders were (5.452±0.136) and (4.371±0.051) mg gallic acid equivalents/g dry weight, respectively (P < 0.05). TFC of RHP and GHP were 14.08±0.11 and 15.37±0.10 mg rutin equivalents/g dry weight, respectively (P < 0.05). Sensory evaluation revealed higher sensory attributes in 1% hot pepper incorporated butter compared to that of the control and 2% hot pepper incorporated butter. Butter incorporated with hot pepper powder showed lower (P < 0.05) peroxide value (2.13 vs. 1.34 meq/kg), free fatty acid contents (0.44 vs. 0.40%) and lower yeast and mold count, compared to the control. This study revealed that hot pepper powder can be successfully used to produce an antioxidant rich spicy flavor salted butter with improved shelf life.

Keywords: Antioxidant; butter; *Capsicum chinense*; hot pepper; rancidity



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Effect of Vacuum Packaging and Storage Conditions on Physicochemical Properties of Selected Sri Lankan Rice Varieties

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The primary staple in the Sri Lankan diet is rice (*Oryza sativa* L.). Sri Lanka cultivates a diverse range of rice varieties under various agroclimatic conditions, each contributing to distinct physicochemical features due to differences in composition. This study aimed to investigate the impact of vacuum packaging and storage conditions on the physicochemical characteristics of selected rice varieties. An experiment was carried out using five different rice varieties cultivated in Sri Lanka. The varieties were V1-Bg 300, V2-Bg 352, V3-At 311, V4-Suwendel, and V5-Suduheenati. Different rice grains were vacuum-packed in polyethylene bags. After that, rice grains in both vacuum and non-vacuum packages were stored under two different storage conditions; 50% of bags in both vacuum and non-vacuum packages were stored under ambient temperature (in the laboratory) while 50% of bags in both vacuum and non-vacuum packages were stored under cold storage. Packaging methods were denoted as P1-vacuum packaging and P2-non-vacuum packaging and storage conditions were denoted as S1-room temperature storage and S2-cold storage. This experiment was laid out in the three-way factorial experimental design. According to the results, there was a wide variation in the physicochemical properties of five different rice varieties. Moisture content varied from 11 to 13%, amylose content varied from 14 to 38%, protein content varied from 7 to 10% and fat content varied from 1 to 5% among all interactions. Gelatinization temperature (GT) of Bg 300, At 311, Suwendel, and Suduheenati were observed commonly intermediate GT (70-74°C) among all interactions except Bg 352 throughout the storage period. Further, GT differed significantly among all the rice varieties ($P < 0.05$). Vacuum packaging emerged as a superior technology for preserving the grain quality of tested rice varieties for up to three months compared to non-vacuum packaging. Both cold and room temperature storage in vacuum-packed rice provided better protection than their non-vacuum counterparts. Physicochemical properties were well-maintained in vacuum-packed rice, while slight disruptions were observed in non-vacuum packaging. The study concluded that cold storage with vacuum packaging exhibited superior performance compared to other treatments.

Keywords: Grain quality, physicochemical properties, rice varieties, storage conditions



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Development of Probiotic Ice Cream; Viability of Probiotic Bacteria (*Lactobacillus acidophilus*, *Bifidobacterium* spp. and *Streptococcus thermophilus*) During Frozen Storage

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Probiotic ice cream is considered a healthy challenge to the ice cream industry, and it was manufactured by fermenting a standard ice cream mix with probiotic strains followed by freezing. However, losses in the viability of probiotic bacteria in ice cream occur either during the production stage or in frozen storage. This study investigated whether the fermentation time affects the viability of probiotic bacteria in ice cream. Fermentation of ice cream mix was carried out using ABT-5 culture (*Lactobacillus acidophilus*, *Bifidobacterium* spp. and *Streptococcus thermophilus*) and the effect of fermentation time was studied at 4, 6, and 8 h incubation periods. The probiotic ice cream was evaluated for probiotic survival, chemical properties, and sensory characteristics during 35 d of frozen storage at -20°C and assessed for the desirable fermentation time in terms of high probiotic survival at the end product. The results of the study showed that fermentation time significantly affected the survival of probiotics in ice cream ($P < 0.05$). The viability of probiotic bacteria in the fermentation time of 4, 6, and 8 h were 7.06, 8.63, and 7.01 log CFU/mL, respectively at d-1 which decreased to 4.23, 6.04, and 4.93 log CFU/mL, respectively after 35 d of storage. The titratable acidity of ice cream samples increased during storage (-20 °C) due to the formation of lactic acid ($P < 0.05$), resulting in a decrease in pH. Total solid content of ice cream products changed between 30.52 and 34.30 (g/100 g) among the ice cream samples. All treatments showed a slightly lower melting rate (g/min) than the control. Organoleptic properties of the product were analyzed using the 9-point hedonic scale with 30 untrained panelists using the Friedman test. Probiotic ice cream fermented for 6 h showed higher overall acceptability, smoothness, taste, creaminess, and aroma than the other treatments ($P < 0.05$). It can be concluded that probiotic ice cream can be produced with 6 h of fermentation time resulting in a high viable cell count of probiotic bacteria and desirable physicochemical and sensory properties.

Keywords: Fermentation time; ice cream; probiotic; storage; viability



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Formulation of a Cookie Incorporating Pumpkin (*Cucurbita maxima*) Seeds and Flour

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Pumpkin is a nutritious food with a lot of health benefits. A significant amount of pumpkin harvest is discarded in Sri Lanka due to post-harvest losses. Fresh pumpkins are highly sensitive to pathogenic microorganisms due to their high moisture content, which limits their shelf life. In Sri Lanka, pumpkin seeds are discarded as waste. This research was aimed to make shelf-stable pumpkin flour from pumpkin flesh, and roasted pumpkin seeds and pave the way to make cookies using pumpkin flour. Cookies were prepared by mixing wheat flour with pumpkin flour and roasted pumpkin seeds in the ratio of 85:5:10, 80:10:10, and 75:15:10% (w/w). A sensory evaluation (appearance, colour, odour, taste, flavour, and overall acceptability) was done using 33 untrained panellists and using the 9-point hedonic scale. Physical properties (weight, height, diameter, spread ratio, and texture analysis), chemical composition (moisture, ash, protein, and fat), and shelf-life analysis (microbial analysis, pH, and moisture) were carried out for the cookies selected from the sensory evaluation. The cookies contained 2.74% moisture, 4.83% crude protein, 27.48% crude fat, and 0.78% ash. For the shelf-life evaluation, cookies were packaged using 20 µm MET CCP/25 µm CCP, and stored at room temperature for 8 wk. The cookies remained in good condition throughout the observation period. Based on the sensory evaluation, the cookies with the ratio of 80% wheat flour: 10% pumpkin flour: 10% pumpkin seed (w/w) were found to have the highest overall acceptability. Cookies with more pumpkin flour had a greater preference from the panellists and richer brown colour compared to the treatments with lower levels of pumpkin flour.

Keywords: Cookies; post-harvest; pumpkin flour; pumpkin seeds; sensory



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Development of Freeze Dried Watermelon (*Citrullus lanatus*) Powder and Evaluation of its Quality Parameters

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Watermelon (*Citrullus lanatus*) is a tropical fruit in Sri Lanka, which is widely consumed as raw fruit or juice. It has three major components; flesh, rind, and seed while red flesh has high essential ingredients such as lycopene and ascorbic acid. However, its high water activity and moisture content make it perishable resulting in high post-harvest losses. Therefore, the study was done to freeze-dry the fruit pulp to a powder using maltodextrin while preserving its natural characteristics and evaluating its quality parameters. Rocky 475 variety was used to prepare the freeze-dried watermelon powder by mixing with different levels of maltodextrin to assess the physicochemical, functional, and proximate parameters of the resulting powder. Among 5, 10, 15, 20, and 25% maltodextrin percentages, 15% was found to be the best level to be added into the watermelon pulp on wet weight basis, which imparts the powder with optimum color, non-adhesiveness, and solubility. Freeze drying resulted in a powder with 20.18±0.9% yield, 0.25±0.05 a_w water activity, 96.0±1.0% solubility, 0.490±0.001 g/cm³ bulk density, 5.38±0.11 pH, 0.52±0.01 titratable acidity, and 5R 8/4 color. The Fourier-Transform Infrared spectroscopy showed a peak at 3741.11 cm⁻¹ which states the O-H stretch with the potential for the presence of phenolic groups. The powder showed high antioxidant activity of 84.81±0.97%, with 8.06±0.05 GAE/g total phenolic content, 97.73±8.54 mg/kg lycopene content and 4.02±0.03 mg/g ascorbic acid content. The proximate analysis showed 3.20±0.001% moisture content, 2.35±0.04% crude protein, 0.94±0.002% crude ash, 0.33±0.001% crude fat, 13.46±0.04% crude fiber, and 80.05±0.50% digestible carbohydrates while containing 332.57 kcal of energy per 100 g. Therefore, the results of the study showed that freeze drying of watermelon pulp with 15% (w/w) maltodextrin can produce a high-quality watermelon powder, which could be successfully used as a raw material to produce a variety of value added food products.

Keywords: Antioxidants; freeze dried powder; maltodextrin; proximate composition; watermelon



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Development of Fruit Wine Incorporated with Black Tea Extract and Evaluation of its Quality Parameters

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Value added tea products are gaining popularity in the market for their significance. Tea wine is a value-added form of beverage with high market potential. This study was conducted to investigate the potential of developing a fruit wine incorporated with black tea infusion and to evaluate its quality parameters. Black tea infusion was prepared by brewing one part of black tea with 6 parts of boiling water for 10 min. Peeled, cored pineapple was cut into small pieces and blended, and the slurry was filtered to obtain the pineapple juice. Six treatments were prepared by using tea infusion and pineapple juice in different ratios. After adding sugar, these samples were fermented with yeast (*Saccharomyces cerevisiae*) for 5 weeks at room temperature. Sensory properties including sweetness, taste, mouthfeel, alcohol strength, aroma and color of the six treatments were evaluated by eight trained panelists using a 7-point hedonic scale. The physicochemical properties of the selected wine sample were evaluated. Sensory data were statistically evaluated by the Friedman test. The wine sample prepared with 2% black tea infusion and 4% pineapple extract was selected as the best. Total polyphenol content as gallic acid equivalent (GAE), antioxidant activity as ascorbic acid equivalent (AAE), alcohol content, caffeine content, pH, titratable acidity as tartaric acid, and total soluble solids contents of the selected wine sample were 2.31 ± 0.19 mg of GAE/mL, 1169 ± 273.08 μ g of AAE/mL, $10.57 \pm 3.27\%$ (v/v), 10.98 ± 2.5 μ g/mL, 3.74 ± 0.01 , 0.22 ± 0.02 g/L, and 10.66 ± 0.57 , respectively. It can be concluded that there is a great potential to develop a fruit wine with unique sensory properties and appreciable physicochemical properties by fermenting a must incorporated with 4% of pineapple juice and 2% of black tea infusion.

Keywords: Antioxidant activity; black tea; fruit wine; pineapple; polyphenol



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Evaluation of Physicochemical and Functional Properties of Guava (*Psidium guajava* L.) Peel Powder as a Potential Food Ingredient

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Guava (*Psidium guajava* L.) is a tropical fruit containing a wide range of nutritional and bioactive compounds. From the total weight of the fruit, nearly 20% is acquired by its peel which is renowned for its functional properties. However, guava peel is often discarded as a guava processing by-product, even though it carries a vast nutritional and bioactive potential. Therefore, the present study aimed to prepare guava peel powder from guava peels, through hot air drying and to evaluate its physicochemical, and functional properties. Guava peels obtained from the locally available guava variety Bangkok Giant Plus were cleaned well and oven-dried at 55°C for 18 h in a hot air oven. Then, the dried peels were ground and sieved through a 100 µm standard sieve to obtain a fine powder and subjected to further analysis. The physicochemical properties of guava peel powder were determined by following appropriate physical and chemical tests. Proximate properties were evaluated by following the standard methods of the Association of Official Analytical Chemists. The ascorbic acid content and the total phenolic content were determined by the iodine titration method and the Folin-Ciocalteu colorimetric method, respectively. Guava peel powder exhibited 0.510±0.01_w water activity, 3.41±0.11 mL/g water holding capacity, 4.65±0.05 pH, and 0.05±0.01 g/cm³ bulk density. Proximate analysis results showed 9.52±2.12% moisture content, 2.60±0.20% crude ash, 3.58±0.09% crude protein, 1.70±0.03% crude fat, 40.07±0.48% digestible carbohydrates, and a higher crude fiber content of 42.52±0.58%. It contained 0.99±0.42 mg/g ascorbic acid content and 191.60±4.84 mg GAE/g total phenolic content. Due to the presence of high fiber content, ascorbic acid content, and phenolic content, guava peel powder can be suggested as a natural functional ingredient in healthy food formulations, with enhanced nutritional and functional value. Moreover, its fiber-rich nature and considerable water-holding capacity could be advantageous in the textural development of appropriate food formulations. Therefore, oven-dried guava peel powder can be incorporated into possible food formulations as a natural food ingredient, which offers the potential to develop a wide range of value-added products with elevated nutritional and functional properties.

Keywords: By-product; functional properties; guava peel; physicochemical



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Development of a Yoghurt Drink Incorporated with Soursop (*Annona muricata*) and Evaluation of its Properties

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Dairy products are widely consumed in worldwide and drinking yoghurt types are becoming the most common among them. Nowadays, consumers intend to consume dairy products with good nutritive value. Soursop (*Annona muricata*) is a tropical climacteric fruit which is considered as an underutilized fruit in Sri Lanka. However, this fruit consists of many nutritional and health benefits. The objective of the study was to develop a soursop incorporated yoghurt drink and to evaluate its properties. Soursop yoghurt drink was developed by incorporating soursop puree (3, 6, and 9% w/w). The soursop yoghurt drink with 9% soursop puree was selected as the most preferable based on the sensory attributes of appearance, color, aroma, taste, mouthfeel, soursop taste, texture, aftertaste, and overall acceptability. Total soluble solids, milk solid non-fat, and total solid contents of selected soursop drinking yoghurt were 15.5°Bx, 8.6%, 23%, respectively. Titratable acidity, pH, and total plate count, *Escherichia coli* count, and yeast and mold count ranged from 0.65 to 1.08%, 4.39 to 3.85, 7×10^4 to 16.3×10^6 CFU/mL, 0 to 1×10^2 CFU/mL, and 0.07×10^3 to 9.67×10^4 CFU/mL within 28 d, respectively. Fat, protein, moisture, and ash contents of the selected product were 3.24, 2.59, 77.00, and 0.73%. The selected sample had a significantly higher antioxidants potential in terms of total polyphenolic content of 80.56 mg GAE/g. According to the shelf-life analysis, the product shelf life was 21 d under refrigerated conditions.

Keywords: Antioxidant; dairy; functional; soursop; yoghurt drink



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Formulation of Coconut Milk Based Frozen Dessert with Desirable Physicochemical and Sensory Properties

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Coconut milk is a non-dairy alternative, which can be used to replace cow's milk in ice cream. This study aimed to develop a formulation for a coconut milk-based frozen dessert and examine the physicochemical and sensory properties of the frozen dessert. Four different formulations (Formulation 1, 2, 3 and 4) of coconut milk frozen dessert were prepared using different levels of coconut milk, skimmed coconut milk and coconut milk powder with four different levels of fat and total solid content in the frozen dessert mixes. A sensory evaluation was conducted to assess consumer acceptability of the developed product. Melting rates, overrun (the amount of air incorporated into the ice cream) and physicochemical properties were determined and the microstructure of coconut milk frozen desserts was observed by a light microscope. A sensory evaluation was done using a 9-point hedonic scale with 30 untrained panelists, and the results were analyzed using the Friedman test. The highest overall acceptability was recorded by formulation 2, which contained 30% coconut milk and 38% skimmed coconut milk. Four formulations were further assessed for the changes in physicochemical properties for one month at freezer condition, and the data were analyzed using a one-way ANOVA. Microbial quality (total plate count, yeast and mold, and coliform) was tested for a 3-wk period. Among the four formulations of frozen desserts, formulation 2 resulted in $1.73 \pm 0.35\%$ protein and $0.40 \pm 0.10\%$ ash content, 6.49 ± 0.10 pH, 26.27 ± 0.38 Brix value, $16.33 \pm 0.58\%$ fat, $44.54 \pm 0.51\%$ total solid, $0.09 \pm 0.01\%$ titratable acidity, $49.79 \pm 1.40\%$ moisture, and 0.45 ± 0.40 g/5 min melting rate. Overall, the results suggested that coconut milk frozen desserts can be prepared using coconut milk or coconut milk powder with desirable sensory and physicochemical qualities.

Keywords: Coconut milk, coconut milk powder, frozen dessert, ice cream, sensory properties



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Effect of Kathurumurunga (*Sesbania grandiflora*) as a Natural Antioxidant on Meat Quality Traits of Marinated Chicken Meat During Refrigerated Storage

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Chicken meat is a good source of high-quality nutrients and hence greatly susceptible to oxidative reactions leading to the development of off-flavors, rancidity, and a decrease in nutritional value. The objective of this study was to evaluate the effectiveness of Kathurumurunga (*Sesbania grandiflora*) leaves powder (KMLP) as a natural antioxidant in marinated chicken meat during refrigerated storage. The chicken meat was marinated using a commercial recipe where sodium tripolyphosphate (STPP) was replaced with KMLP at different levels (w/w); (1) STPP 2% (T1), (2) KMLP 2% (T2), (3) STPP 1%+KMLP 1% (T3), and (4) control without antioxidants (T4). TBARS, pH, water holding capacity, cooking loss, color parameters, and texture were measured over a 28-d refrigerated storage. KMLP showed excellent antioxidant activity as determined by the radical-scavenging activity of 1,1-diphenyl 2-picrylhydrazyl (DPPH). The DPPH values of T3 were significantly higher than other treatments. The increase in TBARS value in KMLP added samples was very slow until 21 d and showed a substantial increase at d 28. TBARS values of marinated chicken meat treated with KMLP and STPP were comparable ($P > 0.05$). The antioxidant activity of KMLP was found to be comparable to STPP. The decrease in pH of T3 was very slow and remained lowest compared to other treatments. T3 exhibited a lower cooking loss than T1 ($P < 0.05$). Marinating chicken meat with KMLP resulted in significantly higher L^* , a^* , and b^* values compared to the control treatment and T1 ($P > 0.05$). The present study demonstrated that the combination of 1% STPP and 1% KMLP was the most effective antioxidant treatment among the treatments used. Based on the results, it can be concluded that commercial STPP can be partially replaced by KMLP as a natural antioxidant in the preparation of marinated chicken meat.

Keywords: Antioxidant activity; cooking loss; lipid oxidation; sodium tripolyphosphate; TBARS



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