



National Symposium on Agriculture & Life Sciences

NSALS '26

BRIDGING INNOVATION AND SUSTAINABILITY:
UNLOCKING THE VALUE OF AGRICULTURAL RESOURCES

22nd Jan 2026

PROCEEDINGS



Faculty of Animal Science and Export Agriculture
Uva Wellassa University of Sri Lanka
www.uwu.ac.lk/nsals

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Acknowledgments

The Organizing Committee of the National Symposium on Agriculture and Life Sciences (NSALS '26) extends its heartfelt appreciation to all individuals and institutions whose invaluable contributions ensured the successful completion of this event. As the 3rd consecutive undergraduate research symposium proudly organized by the Faculty of Animal Science and Export Agriculture (FASEA) of Uva Wellassa University (UWU), NSALS '26 stands as a testament to collective effort, dedication, and academic commitment.

We extend our heartfelt gratitude to our Chief Guest, Senior Professor Kolitha B. Wijesekara, Vice Chancellor of UWU, and our Keynote Speaker, Professor Chalinda K. Beneragama from Faculty of Agriculture, University of Peradeniya. Their scholarly insights and expertise significantly enhanced the academic quality of the symposium. We are also deeply thankful to Professor H.M.S.K. Herath, Dean/FASEA, for invaluable support and guidance throughout the organization of NSALS '26.

Our appreciation goes to Dr. Nishala Wedamulla for delivering an engaging scientific talk at the closing session. We are also grateful for the dedicated efforts of the symposium chairperson, secretary, organizing committee, track coordinators, panel chairs, panel members, and conveners for ensuring the event's smooth execution.

We extend our gratitude to all authors and presenters for sharing their innovative research findings and innovations, which form the heart of the symposium. We convey our gratitude to the Editor-in-Chief, Editorial Board members, and reviewers for maintaining the highest standards in finalizing the proceedings. The exceptional efficiency and unwavering dedication of the working committee leaders and members were pivotal to the success of NSALS '26.

We are thankful to Dr. H.M.S.N. Ariyadasa for CMT management and the Uva Rayon & Audio-Visual Unit for exemplary photography and social media coverage.

We deeply appreciate the financial support provided by our sponsors, including the CIC Agribusiness (Pvt.) Ltd. as the platinum sponsor, Hemas holdings as the gold sponsor, Analytical Instruments (Pvt.) Ltd. as the silver sponsor, and New Anthoney's Farms (Pvt.) Ltd., International Water Management Institute (IWMI), Hemsons International (Pvt.) Ltd., Switz Lanka (Pvt.) Ltd. (Happy Hen Eggs), Avon Pharmo Chem (Pvt.) Ltd., and MicroTech Biological (Pvt) Ltd., as bronze sponsors and all other well-wishers who supported the symposium as track sponsors.

Finally, we express our sincere gratitude to the academic, administrative, and non-academic staff of UWU, and everyone who contributed directly or indirectly to this endeavor. Your commitment and dedication have been integral in fostering undergraduate research and advancing the fields of agriculture and life sciences, and we are deeply appreciative of your efforts.



NSALS '26

Uva Wellassa University of Sri Lanka (UWU) proudly stands at the forefront of higher education as a dynamic, entrepreneurial, and technopreneurial university. With a strong commitment to innovation-driven learning, UWU empowers its graduates with knowledge, skills, and ethical values that prepare them to lead, innovate, and make a meaningful impact on national development.

Celebrated as the Center of Excellence for Value Addition to Sri Lanka's national resource base, UWU continues to inspire research excellence and transformative innovation. As part of this vibrant academic culture, the Faculty of Animal Science and Export Agriculture (FASEA) proudly presents the third annual National Symposium on Agriculture and Life Sciences (NSALS '26) the Undergraduate Research Symposium of FASEA-UWU.

Building on the success of its inaugural event in 2024, the third consecutive symposium of the faculty, NSALS '26 brings together young researchers, academics, industry leaders, and scientific professionals on a single platform to share ideas, exchange knowledge, and spark collaborations. Under the theme "Bridging Innovation and Sustainability: Unlocking the Value of Agricultural Resources", this national symposium aims to redefine existing knowledge frameworks, inspire forward-thinking solutions and creative approaches to the challenges facing agriculture and life sciences today.

NSALS '26 showcases cutting-edge undergraduate research across eight (08) dynamic thematic tracks in agriculture and life sciences sector:

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

This year, 188 high-quality undergraduate research papers under diverse disciplines were selected for oral and poster presentation physically at UWU premises following a stringent peer-review process. These research findings highlight the enthusiasm, innovation, and research potential of the next generation of scientists and professionals. NSALS '26 is a celebration of knowledge, creativity, and collaboration reinforcing UWU's commitment to shaping a sustainable future through innovation and discovery.



Chief Guest's Message



I am pleased to extend my warm greetings on the occasion of the inaugural National Symposium on Agriculture and Life Sciences (NSALS '26), hosted by the Faculty of Animal Science and Export Agriculture of Uva Wellassa University. Under the theme "Bridging Innovations and Sustainability: Unlocking the Value of Agricultural Resources," this landmark event reflects the faculty's strong commitment to academic excellence, research innovation, and sustainable development in agriculture and life sciences.

NSALS '26 brings together scholars, researchers, industry professionals, and students to exchange knowledge, stimulate innovation, and explore sustainable responses to contemporary agricultural challenges. The symposium offers a valuable platform for undergraduate researchers to present their work, engage in scholarly dialogue, and gain multidisciplinary perspectives. By linking research with real-world applications, it fosters an intellectually vibrant environment that encourages impactful and sustainable solutions.

I sincerely commend the organizing committee and the Faculty of Animal Science and Export Agriculture for their dedication to realizing this important national initiative. I extend my best wishes to all presenters, speakers, and panelists for a successful and inspiring symposium. May your contributions enrich academic discourse, inspire innovation, and contribute meaningfully to the future of agriculture and life sciences.

Senior Professor Kolitha B. Wijesekara

Vice Chancellor

Uva Wellassa University of Sri Lanka



Dean's Message



It is with great pleasure and pride that I forward this message on the occasion of the third consecutive research symposium, the National Symposium on Agriculture and Life Sciences (NSALS '26), held under the theme "Bridging Innovation and Sustainability: Unlocking the Value of Agricultural Resources", and organized by the Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka. The faculty has conducted this symposium annually since 2024. Accordingly, NSALS '26 provides a valuable platform for budding researchers to present their research findings and gain experience essential for their future engagement in the research world. Extending beyond Uva Wellassa University, NSALS '26 also offers opportunities for undergraduates from other universities across the country. Thus, we believe that this symposium has evolved into a national-level platform that enables undergraduates to share and discuss their recent scientific findings in the fields of agriculture and life sciences.

Representing the Faculty of Animal Science and Export Agriculture, undergraduates from the degree programs BScHons (Animal Production and Food Technology), BScHons (Export Agriculture), BScHons (Tea Technology and Value Addition), BScHons (Palm & Latex Technology and Value Addition), BScHons (Aquatic Resources Technology), and BScHons (Plantation Management and Technology) present their research findings at this symposium. The symposium focuses on eight main tracks, namely: Crop Production Technology; Food Science and Technology; Animal Production and Technology; Aquatic Sciences; Agricultural Economics and Agribusiness Management; Extension and Entrepreneurship; Agricultural Engineering and Process Technology; Agricultural Microbiology and Biotechnology; and Environmental Science and Climate Change, covering the key disciplines within the scope of agriculture and life sciences. Since its inception, Uva Wellassa University has taken responsibility for producing graduates capable of making significant contributions to the national economy through value addition to the country's resource base. Accordingly, the University provides entrepreneurial education alongside core academic subjects within all undergraduate curricula, while also striving to deliver industry-relevant knowledge, skills, and attitudes demanded by employers. In this context, providing opportunities for undergraduates to communicate their research findings related to innovation and research through NSALS ' 26 is a valuable investment in the future.

I am confident that NSALS '26 will undoubtedly enhance the research culture within the faculty and beyond. Therefore, I take this opportunity to sincerely appreciate all the organizers and presenters of NSALS '26 for their commitment and dedication toward the successful completion of this event.

Professor H.M.S.K. Herath

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



NSALS '26 Chairperson's Message



It is with great pleasure and enthusiasm that I welcome you to the National Symposium on Agriculture and Life Sciences (NSALS '26), to be held on 22nd January 2026 at Uva Wellassa University of Sri Lanka. This undergraduate symposium, organized by the Faculty of Animal Science and Export Agriculture, continues its commitment to nurturing young researchers while fostering scholarly excellence, innovation, and collaboration in addressing contemporary challenges in agriculture and life sciences. The theme of NSALS '26, "Bridging Innovation and Sustainability: Unlocking the Value of Agricultural Resources," highlights the critical need to harmonize technological advancement with sustainable resource management. Sri Lanka's agricultural sector offers immense potential for value addition through advances in crop and animal production, food processing technologies, aquatic and environmental sciences, agricultural engineering, and biotechnology. This symposium provides a dynamic platform for undergraduate researchers to present original findings, explore interdisciplinary perspectives, and translate scientific knowledge into practical and scalable solutions. NSALS '26 aims to bridge research with policy, industry, and community needs by encouraging dialogue across diverse domains including production systems, agribusiness, resource economics, extension, entrepreneurship, and sustainable processing technologies. Throughout the symposium, participants will engage with a wide range of research addressing productivity enhancement, food and feed innovation, climate-resilient systems, microbial and biotechnological applications, resource efficiency, and environmental stewardship. The keynote address, oral presentations, and poster sessions will showcase innovative undergraduate research that contributes meaningfully to national development priorities and global sustainability goals. Beyond the exchange of knowledge, NSALS '26 offers an invaluable opportunity to build professional networks and collaborative partnerships. I hope the discussions initiated here will inspire confidence, curiosity, and a lifelong commitment to innovation-driven sustainability. I extend my sincere gratitude to the Vice Chancellor, Dean of the Faculty, keynote speaker, organizing committee, sponsors, reviewers and volunteers for their tremendous dedication and support. I warmly welcome all participants and wish you a rewarding and intellectually enriching symposium. Together, let us bridge innovation and sustainability to unlock the true value of agricultural resources for a resilient future.

Professor Deshani C. Mudannayake

Chairperson, NSALS '26

Faculty of Animal Science and Export Agriculture

Uva Wellassa University of Sri Lanka



NSALS '26 Secretary's Message



It is my great privilege to extend this message for the 3rd National Symposium on Agriculture and Life Sciences 2026 (NSALS '26), organized by the Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka.

Building on the strong foundation laid by previous symposia, NSALS '26 continues to provide a vibrant platform for Sri Lankan undergraduates to present their research, exchange ideas, and engage in constructive dialogue in the fields of Agriculture and Life Sciences under the theme of "Bridging Innovation and Sustainability: Unlocking the Value of Agricultural Resources". At a time when environmental, social, and economic challenges are becoming increasingly complex, the fresh perspectives and innovative

thinking of our undergraduates are vital for shaping a sustainable future.

NSALS '26 not only celebrates undergraduate research but also strengthens the bridge between academia, industry, and the wider community. It aligns with the vision of Uva Wellassa University to be a centre of excellence for value addition to the national resource base, by encouraging research that is relevant, innovative, and impactful. Through this symposium, we aim to foster collaborations, inspire critical thinking, and promote solutions-oriented research that can contribute meaningfully to national development.

As the Secretary of NSALS '26, I wish to express my heartfelt gratitude to the Vice Chancellor of Uva Wellassa University, the Dean of the Faculty of Animal Science and Export Agriculture, all academic and non-academic staff members, sponsors, and well-wishers for their unwavering support, guidance, and encouragement in making this event a reality. I also extend my sincere appreciation to the organizing committee and supportive staff members of NSALS '26 for their dedication, hard work, and collective effort in organizing this symposium. I am confident that NSALS '26 will provide a fertile ground for ideas to flourish, networks to grow, and meaningful collaborations to emerge among undergraduates, academics, researchers, and industry stakeholders. I wish all participants a productive, enriching, and inspiring experience at NSALS '26 and look forward to witnessing the valuable contributions and innovative outcomes that will arise from this symposium in advancing Agriculture and Life Sciences.

Dr. G. Abhiram

Secretary, NSALS '26

Faculty of Animal Science and Export Agriculture

Uva Wellassa University of Sri Lanka



Keynote Speech

“Illuminating the Future: Bridging Photobiological Innovation with Sustainable Food Systems”



The foundational role of light in agriculture is being radically redefined. Moving beyond sunlight as a mere environmental factor, we now approach the light spectrum as a precise, tunable input; a primary agricultural resource to be managed with the same sophistication as water or nutrients. This paradigm shift, powered by photobiological innovation, is central to bridging the gap between agricultural productivity and ecological sustainability. By unlocking the photobiological code of plants, we can design food systems that are not only more productive but also intrinsically efficient, resilient, and synergistic with energy production.

Decoding the Photobiological Lexicon: Beyond PAR to Plant-Centric Signaling

Modern photobiology treats light as a complex information signal. Recent research reveals the critical regulatory roles of wavebands outside the classic 400-700 nm range. Strategic application of Far-red radiation (700-750 nm) during specific growth stages can enhance fruit set or direct energy to harvestable organs, minimizing structural waste. Conversely, low-dose, pulsed UV-B light can act as an eustressor, upregulating specific branches of secondary metabolism to enhance concentrations of nutraceuticals like anthocyanins in leafy greens or glucosinolates in brassicas. This turns a protective response into a tool for nutrient-dense crop production. Furthermore, the concept of light compensation point is now spectrum-specific; under a blue-deficient spectrum, for instance, plants may exhibit a higher net photosynthetic rate at lower irradiances, altering energy use calculations in controlled environments. Understanding this expanded spectral lexicon where light quality dictates morphology, chemistry, and physiology, is the essential first step toward precision plant stewardship.

Precision Lighting: From Static Recipes to Dynamic Photobiological Feedback Loops

Light-Emitting Diode (LED) technology has liberated us from the static solar spectrum, enabling spectral programming. We are evolving from applying broad-spectrum ‘white light’ to crafting targeted light recipes. Evidence now solidifies that green light (500-600 nm), once considered photosynthetically weak, plays a crucial role in whole-canopy photosynthesis due to its superior penetration, activating photoreceptors in lower leaves and improving overall photosynthetic efficiency in dense canopies. This has direct implications for vertical farming and greenhouse interlighting strategies. The real frontier, however, is moving from pre-set recipes to dynamic lighting systems. The integration of non-invasive sensors, such as hyperspectral imaging and chlorophyll fluorescence monitors, with AI-driven control systems, allows for real-time photobiological feedback. An AI model can interpret early fluorescence signatures of nutrient deficiency or water stress and modulate the light spectrum, for instance,



increasing blue or specific red ratios to mitigate the stress or steer metabolism before visible symptoms occur. This creates a closed-loop "plant-talk-to-light" system, optimizing plant health and resource use simultaneously.

Synergistic Systems: Agrovoltatics and the AI-Optimized Lightscape

Agrovoltatics, co-locating solar photovoltaics with crops, is the definitive bridge between innovation and sustainability. The challenge is engineering a dynamic lightscape, not just managing shade. Photobiology guides next-generation PV design, like semi-transparent cells that transmit optimal red/blue light while harvesting other wavelengths. Crop selection targets photobiological suitability, favoring species that thrive under partial panels. Here, Artificial Intelligence becomes the essential orchestrator. Machine learning models, integrating microclimate, soil, and plant data, perform multi-objective optimization. They determine the panel layouts and schedules that maximize the dual yield of kilowatt-hours and kilograms, adaptively balancing energy generation with crop needs to maximize total resource output per unit of land.

The Path Forward: Cultivating a Photobioliterate Profession

Realizing this future requires a fundamental evolution in agricultural education and research. We must cultivate a new generation of photobioliterate agronomists and professionals who are as fluent in interpreting a phytochrome photoequilibrium chart as a soil test report. The undergraduate curriculum must integrate core principles of environmental plant physiology and photobiology with data science. Concurrently, research priorities must extend beyond discovery to robust lifecycle and techno-economic analyses of spectral-tuning systems, ensuring their environmental and financial sustainability. Equally important is the democratization of this technology through the development of low-cost, spectral-specific sensors for open-field use, allowing traditional farmers to benefit from light-quality diagnostics.

In conclusion, mastering the light spectrum is the essential bridge between innovation and sustainability. It allows us to replace blunt-force inputs with information, transform waste (like excess heat from solar panels) into productive niches, and design systems that generate multiple resources from a single footprint. By bridging deep photobiological knowledge with intelligent technologies like AI and synergistic frameworks like agrovoltatics, we do not just use light; we converse with it to unlock the profound, untapped value within our agricultural systems. The future of agriculture is not merely bright-it is intelligently illuminated.

Professor Chalinda K. Beneragama

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**AGRICULTURAL ECONOMICS, AGRIBUSINESS MANAGEMENT,
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Paper ID: NSALS '26-020 (Oral)

Evaluating the Impact of Sensory Branding on Consumer Satisfaction and Purchase Intention: A Study at Planters Grove Tea Center; Kelani Valley Plantations PLC

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Consumer experiences at tea centers increasingly extend beyond product quality, highlighting the importance of sensory branding. This study investigates the impact of sensory branding on consumer satisfaction and purchase intention, focusing on Planters' Grove Tea Center, which belongs to Kelani Valley Plantations PLC (KVPL) in Sri Lanka. The center currently faces lower consumer engagement compared to other leading tea tourism destinations. To address this issue, this research explores how sensory branding can be effectively utilized to enhance customer satisfaction and drive stronger purchasing intentions by engaging consumers' senses and emotions. The study examined five sensory elements: sight, sound, smell, taste, and touch to determine their individual and collective effects on consumer satisfaction. Data were collected using a systematic random sampling technique from a sample of 175 respondents, including both local and foreign consumers, by distributing a structured questionnaire. Using quantitative analysis supported by qualitative insights, the results revealed that sight, taste, and smell significantly influence satisfaction, while sound and touch, though less dominant, positively contribute to the overall sensory experience. Statistical analysis using ordinal logistic regression confirmed that these sensory variables have meaningful relationships with satisfaction at varying significance levels. Based on these findings, tea centers can strategically prioritize their investments according to the strength of influence demonstrated by each sensory factor, ensuring optimal allocation of resources for experience enhancement. Furthermore, the study identified a strong positive correlation between consumer satisfaction and purchase intention ($R^2=0.72$, $P<0.001$), indicating that higher satisfaction levels derived from sensory experience lead to increased likelihood of repeat visits, higher spending, and positive word-of-mouth. These findings suggest that sensory branding serves not only as an aesthetic enhancement but as a powerful strategic tool for building consumer loyalty and improving financial performance. The practical implications of this research extend beyond Planters' Grove Tea Center. Insights gained can be applied across other tea centers to strengthen their competitive position within Sri Lanka's tea tourism sector. By adopting a well-structured, multi-sensory branding approach, KVPL can transform its tea centers into distinctive experiential destinations that enhance consumer engagement, satisfaction, and long-term brand loyalty.

Keywords: Consumer satisfaction; KVPL; purchase intention; sensory branding; tea centers



Paper ID: NSALS '26-025 (Oral)

Changes in Tea Consumption Patterns before and after the Covid-19 Pandemic: A Comparative Study of Black and Green Tea in Western Province, Sri Lanka

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Tea has been the focus of Sri Lankan culture historically, with black tea having been the most popular for many years. The COVID-19 pandemic, however, inserted drastic lifestyle and health habits changes into people's perspectives around the globe that have affected their consumption patterns. This study investigates shifts in black and green tea consumption patterns in Sri Lanka's Western province before and after the COVID-19 pandemic, with special emphasis on changes in consumption behavior over time. The study applied a quantitative methodology based on a structured questionnaire completed by 200 randomly selected tea consumers. Descriptive statistics and multinomial logistic regression were employed in the data analysis to identify overall consumption habits and examine the impact of health consciousness, lifestyle modifications, and consumers' attitudes toward tea selection. Observations show that total tea consumption increased after COVID-19 pandemic, with the green tea segment recording a significant increase in consumption. It is powered partly by increasing health consciousness and consumer preference towards functional drinks that are perceived to boost immunity and general well-being. Although black tea remains the most popular, its share of consumption has declined slightly compared to pre-pandemic times as an indication of a gradual shift of consumer taste away from homogeneity. Significantly, the pandemic motivated consumers to rethink past consumption trends and seek alternatives better suited to new health requirements. The findings evidence that tea in Sri Lanka is increasingly appreciated both as a cultural good and a health-focused beverage. Operators in the industry must place greater emphasis on strengthening marketing on green tea and creating innovative value-added varieties that respond to evolving consumer needs. The study overall enables one to understand the new dynamics of tea drinking during the post-pandemic scenario and provides policymakers and manufacturers with insights to align their strategies with the new trends.

Keywords: Black tea; COVID-19; green tea; Sri Lanka; tea consumption



Paper ID: NSALS '26-047 (Oral)

Adoption of Digital Transformation in the SME Sector: A Case of Agri-food Manufacturing SMEs in Badulla District

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Small and Medium Enterprises (SMEs) form a key pillar of Sri Lanka's economy, and the agri-food production sector is particularly vital for rural areas such as Badulla. Despite the fact that the experience gains of digital transformation in higher competitiveness, operational efficiency, and sustainability are recognized, the uptake of digital technologies in this sector remains low. This study aims to assess the extent to which digital transformation is being adopted by agri-food SMEs in Badulla District and identify the major factors and challenges associated with this adoption process. Primary data were obtained from 60 SME owners using structured questionnaires and in-depth interviews. The approach used descriptive statistics, correlation techniques, and an ordered logit regression model, with statistical significance ($P < 0.05$), explaining 71.24% of the variation in digital adoption behavior among firms. Evidence indicates that while some SMEs that have a high willingness to exploit digital technology, including social media, mobile applications, and payment systems, there are quite a number that are constrained by insufficient finances, weak technological infrastructure, low digital literacy, and inadequate market access. Enterprise internal competence and positive perceptions of technology were found to be drivers of digital technology adoption, whereas geographical remoteness, infrastructural weaknesses, and socio-cultural constraints are barriers. These results underscore the necessity of more targeted policy interventions, capacity building programs, and greater availability of digital technologies and training programs for boosting the digital readiness of rural SMEs. This research contributes valuable empirical insights to the argument on digital transformation among developing economies and offers practitioners and policymakers with important actionable recommendations for facilitating inclusive digital growth in the agri-food industry.

Keywords: Agri-food manufacturing; digital transformation; ordered logit model; SMEs



Paper ID: NSALS '26-052 (Oral)

An Economic Analysis of Potato Farming under High Input Costs: A Case Study of Welimada DS Division

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This study examines the economic analysis of increasing input cost for potato producers in the Welimada district secretary division in Sri Lanka in relation to profitability, cost structure and sustainability. Primary data were collected from 60 farmers through simple random sampling. Structured questionnaires and interviews were used for data collection. Secondary data were collected from official sources. Statistical analysis was done using SPSS and Excel. These seeds, fertilizer, labor and machinery are the primary cost elements affecting the overall cost of potato producers. Seed costs were projected to be over 50% of the total cost of production in 2024. Fertilizer prices fluctuated in relation to national policy decisions, while labor and machinery costs continued to increase, thereby decreasing overall profitability. Despite these limiting factors, there were a handful of farmers who were able to convert a profit as a result of the efficient use of resource along with management practice adjustments. It was also discovered that only 1/3 of the farmers were utilizing sustainable practices such as crop rotation, organic fertilization, integrated pest management etc. High start-up costs, limited technical knowledge, and a lack of government support were major barriers to adopt those sustainable practices. Average yield in 2024 was 4,678 kg/acre, far below the potential yield of 8,000 kg based on data from the Department of Agriculture, primarily due to inadequate application of inputs and deteriorating soil fertility. Recommendations include promoting low-cost organic inputs, enhancing farmer training, providing subsidies, stabilizing market conditions, and improving infrastructure to enhance economic stability and environmental sustainability. These findings contribute to national agricultural priorities by offering insights into reducing import dependency and enhancing food security in Sri Lanka.

Keywords: Input costs; potato; profitability; sustainability; Welimada DS division



Paper ID: NSALS '26-053 (Oral)

Evaluating the Influence of Service Quality Dimensions on the Retention of Existing Tea Manufacturers: A Case Study of Asia Siyaka Commodities PLC

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It is crucial to retain the existing tea manufacturers to ensure sustainability and success of the tea brokerage industry in Sri Lanka. Even if it is accepted that service quality plays an important part in building long-run relationships, research that describes how specific aspects of service quality affect tea manufacturer retention is limited within the Sri Lankan tea brokerage industry. This research aims to explore how aspects such as tangibility, reliability, responsiveness, accessibility, and empathy affect tea manufacturer retention as part of Asia Siyaka Commodities PLC's current partnership. The research design involved a quantitative approach and adopted a cross-sectional design. The data collection involved the usage of a structured format for the questionnaires conducted on the tea manufacturing companies that belonged to the low-grown, mid-grown, and high-grown regions and consisted of 60 companies. The service quality dimensions were the independent variables, and the dependent variable involved the retention of the manufacturers. The correlation analysis showed that all five factors had positive and significant correlations (r) with tea manufacturer retention, with values above 0.70, which represent strong positive correlations. The regression analysis also showed that all factors had direct and significant influences on tea manufacturer retention ($P < 0.05$). The findings showed that the overall most influential factor was reliability ($\beta = 0.42$), trailed by responsiveness ($\beta = 0.36$). Tangibility ($\beta = 0.24$) and accessibility ($\beta = 0.21$) had moderate and positive influences, while empathy ($\beta = 0.18$) had the lowest positive influence. The overall model explained a large proportion of variance in tea manufacturer retention, thus providing evidence that all factors were collectively important within the context of influencing retention by tea manufacturers. The results emphasize the importance of reliable, precise, and up-to-date brokerage services in improving manufacturer satisfaction and maintaining continued retention. This research provides valuable insights and empirical data that help improve service strategies and shed some light on the scarce literature available on service performance and retention in the tea brokerage industry in Sri Lanka.

Keywords: Reliability; responsiveness; service quality; Sri Lankan tea industry; tea brokerage industry; tea manufacturer retention



Paper ID: NSALS '26-066 (Oral)

Impact of Intercropping on the Income of Rubber Smallholders in the Monaragala District of Sri Lanka

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Natural rubber (*Hevea brasiliensis*) is one of the main agricultural commodities in Sri Lanka, expanding to non-traditional areas such as Monaragala due to the limitation of land availability in the Low Country Wet Zone. However, rubber smallholders in non-traditional areas such as the Monaragala district face major challenges due to delayed latex harvest, low productivity and volatile market prices. These constraints limit household income and the livelihood stability. Therefore, intercropping has been introduced as a viable solution to diversify income, improve land productivity, and reduce farmers' financial risks. This study was conducted to assess the impact of intercropping on the income of smallholder rubber farmers in the Monaragala district. Primary data were collected from 70 smallholder farmers using a structured questionnaire and key informant interviews. Descriptive and regression analyses were applied to study the intercropping patterns among small holders and the effect of intercropping on monthly income. As per the results, 78.57% of the respondents cultivate intercropping, with cocoa (*Theobroma cacao*), banana (*Musa* spp.) and pepper (*Piper nigrum*) being the dominant intercrops due to their commercial value and compatibility with rubber. Further, the majority of farmers reported experience of intercropping for more than two years, and through income analysis, it can be revealed that banana and pepper significantly improved household income ($P < 0.05$), while cocoa yielded mixed results depending on environmental and management conditions. Farmer experience and adoption of land cover also show a positive correlation with income, whereas sloped land benefits were negatively affected. The study confirmed that intercropping significantly improves the socio-economic resilience of smallholders and provides both short-term and long-term income streams, reduces income risk during the immature rubber stage, and promotes environmental sustainability through better land and soil management. The study concludes that intercropping is an economically and environmentally viable farming system for smallholder rubber estates in Monaragala. Policy measures that focus on farmer training, improved market access and the promotion of regionally specific intercropping models are essential to maximize benefits.

Keywords: Income diversification; intercropping; livelihood resilience; Monaragala district; rubber smallholders; sustainable agriculture



Paper ID: NSALS '26-080 (Oral)

Intrahousehold Decision Making and Food Security in Sri Lanka

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This study is an attempt to estimate the impact of intra-household decision-making on food security in Sri Lanka. The data was obtained from the Household Income and Expenditure Survey (2019) conducted by the Department of Census and Statistics in Sri Lanka. Food security was measured using a nutrition-based approach, calculated from the daily per capita calorie intake relative to the recommended dietary requirement of 2030 kcal per person per day. The nutrition-based Food Security Index was used to assess food security. The data was measured by the OLS technique. The results revealed clear gender differences in the determinants of household food security. Remittance receipt is negatively associated with food security in male-headed households, while no statistically significant effect is observed among female-headed households. More educated households and government-sector employment significantly improve food security among female-headed households, but no significant effect was identified in male-headed households. Private-sector employment and household size are associated with lower food security in both household types. Moreover, a higher number of workers in a family is associated with higher food security in both household types, highlighting the role of demographic and spatial vulnerabilities.

Keywords: Food security; gender; Sri Lanka



Paper ID: NSALS '26-088 (Oral)

Factors Influencing the Performance of Small and Medium-scale Rice Mills in the Hingurakgoda DS Division, Polonnaruwa District

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The rice milling sector is the largest agro-based industry in Sri Lanka, serving as a critical engine for the national economy and the backbone of food security. However, small and Medium-sized Rice Mills (SMRs) keep facing persistent issues such as high operational expenses, limited financial access, unpredictable market pricing, and the use of out-of-date technology, all of which reduce productivity and sustainability. The purpose of this study was to identify and rank the important elements influencing SMR performance in the Hingurakgoda divisional secretariat division, Polonnaruwa district, using the Relative Importance Index (RII) methodology. To ensure proportional representation, 50 rice mill owners were identified from a population of 98 registered SMRs employing stratified random sampling techniques. Primary data were collected through face-to-face interviews using a structured questionnaire. Secondary data were obtained from government records and literature review. The data were analyzed with SPSS software. The RII was measured by calculating the weighted average of respondent ratings using the formula on the highest scale and rate from 0 to 1 covering influencing rice mill performance by economic (market power), technological (regular maintenance), operational (time management), and performance (cost). The results showed that technological and operational factors had the largest influence on rice mill performance, with the highest RII values observed for regular machinery maintenance (0.912) and time management (0.924), respectively. These findings emphasize the value of modernization, process optimization, and effective management methods. Economic elements, such as government policies and subsidies (0.356), as well as performance-related factors like income and profit (0.436), were ranked less significant. Overall, the study indicates that technical innovation and good operational management are critical to boosting efficiency, reducing downtime, and increasing profitability in SMRs. It also suggests that authorities implement targeted financing schemes, technical support programs, and subsidized machinery upgrades to improve the long-term viability and competitiveness of small and medium-sized rice mills in Sri Lanka.

Keywords: Operational efficiency; RII; rice milling; SMRs; technological factors



Paper ID: NSALS '26-089 (Oral)

Factors Influencing the Sustainability of Agro-based Lacquer Handicrafts in Rural Sri Lanka; A study in Rattota DS Division, Matale District

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The traditional agro-based handicrafts industry is an important sector in Sri Lanka, with both cultural and economic value as a long-term source of income. It highlights the rich cultural legacy of the country while also providing economic prospects for rural people. Artisans in this sector face obstacles such as economic hardship, limited market access, and limited exposure to current technologies. This study will investigate the important parameters influencing the sustainability and development of agro-based lacquer handicraft craftsmen in Pahala Hapuvida, with an emphasis on economic, technological, and social issues. The study was carried out in Pahala Hapuvida, Matale district of Sri Lanka between May to October 2025. The study focused on all 76 active artisans. The entire population was surveyed (76) using a census method. Primary data were gathered by face-to-face interviews and phone surveys using a pre-tested questionnaire that includes production, technological, economic, and social and institutional characteristics. Descriptive statistics were used to process the five-point Likert scale data, which ranged from strongly disagree (1) to strongly agree (5). Data were analyzed with IBM SPSS 25 software. According to reliability analysis, each factor exceeded than the acceptable threshold (0.6). The industry indicates significant growth potential due to its strong artisan commitment to production, high profitability, and stable market. The shift from stable survival to profitable production is currently constrained by restricted access to machinery and growing material costs, even though current manufacturing innovations have already improved quality. The industry has the capability to transform its current market demand into long-term socioeconomic resilience and industrial development by filling in these shortages in infrastructure and encouraging youth involvement. The findings show that the agro-based lacquer handcraft sector has high sustainability potential. Expanding institutional support and market access will promote rural livelihoods while preserving this vital component of the national cultural heritage.

Keywords: Agro-based lacquer handicrafts; artisan sustainability; economic and social development; rural livelihoods; technological factors



Paper ID: NSALS '26-130 (Oral)

Assessing the Adoption of Certification among Tea Manufacturers: A Case Study of a Brokering Company in Sri Lanka

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The Sri Lankan tea sector is one of the largest in the country exporters and employers, but growing globalization has made level standards of certification necessary to be competitive in markets like the European Union and Japan. Certification standards such as ISO 22000, HACCP, GMP, Rainforest Alliance, and Fairtrade provide assurance on the safety of the foods, sustainability, and ethical production, but the adoption of Sri Lankan factories is uneven. The aim of the study is to examine the level of adoption and contributing factors to the adoption of the certification by tea producers who are registered by a selected brokering company in Sri Lanka. A quantitative research design adopted a structured questionnaire randomly distributed to 60 factories that were chosen by stratified random sampling. Descriptive statistics and multiple linear regression were used to test the data using SPSS 27.0.1 software. Number of adopted certifications was the dependent variable and independent were demographic, profile of the factory, and perceptual factors. Results indicate that three to four certifications were implemented by the majority of the factories, with the highest number of implementations of the ISO 22000. The regression model was statistically significant with $R^2=0.823$, indicating that 82.3% of the variance in the adoption of certification could be explained by the predictors. Significant positive effects ($P=0.05$) were found on perceived advantage, perceived behavioral control, and ease of the certification process, while education level and level of income were not statistically significant. Perceived cost and age showed statistically significant negative effects on certification adoption. Due to insufficient statistical evidence, no conclusive inference could be made regarding gender, years of operation, factory size, and ownership type. Overall, findings indicate perceptual factors exert stronger influence than demographic factors. Certification costs can be reduced and procedures simplified to overcome adoption challenges, particularly among small and medium-scale producers, as supported by significant regression results at $P=0.05$. Brokering companies have a critical role to provide adoption facilitation by advisory and buyer linkages.

Keywords: Adoption; broker; manufacturers; perceptual factors; quality certification; tea industry



Paper ID: NSALS '26-141 (Oral)

Analysis of Consumer Awareness, Preference, and their Impact on the Market Positioning of Probiotic Dairy Products in Major Cities in Sri Lanka

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Functional foods, including probiotic dairy products, are expanding globally due to their health benefits, such as improving gut microbiota, enhancing immunity, and reducing digestive disorders. Sri Lankan consumers show limited understanding of probiotics, their health benefits, and regulatory standards. The objective of this study was to analyze consumer awareness and preferences for probiotic dairy products and to evaluate their impact on the market positioning of these products in major cities of Sri Lanka. A structured questionnaire survey was conducted with 226 respondents (Colombo: 78, Galle: 78, Kandy: 70), including demographics, consumer awareness, consumption behavior, health benefits, price consideration, taste preferences, brand certifications, legal awareness, and label reading behavior. Questionnaires were distributed through healthcare, banking, higher education, and technology sectors. These sectors were selected according to their knowledge about probiotics, their health benefits, and label-reading behavior. Results showed that 60.2% of respondents lacked awareness of overall probiotics knowledge, and from that, 62.2% lack of awareness of probiotic regulations (According to ISO 29981), with Colombo showing the highest awareness (mean=2.87), followed by Galle (mean=2.72) and Kandy (mean=2.47). Awareness was highest among the healthcare sector (mean=3.54) and postgraduates (mean=4.50). Label reading behavior was highest in Colombo (mean=3.36), and from all four sectors, the healthcare sector (mean=3.78) has the highest label reading behavior. Supermarkets were the primary buying location, with Highland, Kotmale, and Anchor being the most recognized brands. Results showed that there were no significant differences in brand selection when purchasing probiotic dairy products. Regression analysis identified consumer awareness, label reading behavior, product brands, legal certifications, and probiotic dairy products consumption as significant predictors of market positioning. Price consideration had a negative correlation, health benefits and taste preferences showed moderate correlations, but were not significant predictors. These findings showed the need for targeted educational campaigns to improve consumer awareness and understanding of probiotic regulation. Marketing strategies should emphasize brand credibility and certifications, simplified packaging to enhance label readability, and value-based promotions to mitigate price sensitivity. Strengthening these factors can significantly improve the market positioning and consumer adoption of probiotic dairy products in Sri Lanka.

Keywords: Consumer awareness; consumer preference; health benefits; market positioning; probiotic dairy products; Sri Lanka



Paper ID: NSALS '26-156 (Oral)

Appraising Tea Smallholders' Satisfaction on Tea Factory and Society-based Extension Services: A Case Study on Bought Leaf Supply Chain of Aruna Tea Factory in Passara

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The tea smallholders are important to the tea industry in Sri Lanka and provide a large contribution to the national production. Smallholders' satisfaction with extension services is important. Lack of attention to farmers' satisfaction on Factory and Society-based (FnS) extension programs in Aruna Tea Factory can lead to low productivity and sustainability. Therefore, the study is exploring the satisfaction of tea smallholders towards the FnS extension services of Aruna Tea Factory in the Passara region in Badulla, and the sample of 100 registered smallholders was selected through convenience sampling. The research aimed at assessing the level of satisfaction of the smallholders with FnS services, identifying the factors affecting their satisfaction, evaluating the smallholders' perception on price fluctuations and income instability, and provide improvement recommendations. The pre-tested questionnaire, interviews, and field observations were used to collect data. To measure the variables 5-point Likert scale scoring was used, and socio-demographic data were measured either categorically or continuously. Data analysis involved the SPSS software, correlation analysis, and multiple linear regression analysis. The results indicate moderate satisfaction (51%) on FnS extension services, and 42% of respondents expressed a neutral perception regarding price fluctuations and income instability. The sample represents the typical Sri Lankan smallholders, who are mostly older men with low education levels, and experience based differences are observed. The coefficient of determination is very high, ($R^2=0.788$), that explains 78.8% of the variance in the levels of satisfaction is explained by the independent variables used in the model. Regression analysis shows the great positive predictors, including timeliness of services, appropriateness of activity coverage, usefulness, and quality of extension delivery. Recommendations included scheduling training sessions early, geographic expansion, implementation of technical knowledge development programs, establishing the performance monitoring systems, and annual satisfaction surveys. Constant monitoring through farmer feedback and the satisfaction surveys will ensure the effective delivery of extension services and facilitate the sustainable tea production.

Keywords: Extension services; factory and society; satisfaction; tea smallholders



Paper ID: NSALS '26-158 (Oral)

An Assessment of Digital Literacy among Rubber Smallholders in Monaragala District

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Monaragala is a nontraditional rubber-growing area in Sri Lanka, where smallholders dominate in rubber production. Even though rubber income plays a key role in rural livelihoods, there are many influential factors such as low yields, income fluctuations and limited knowledge that can influence the income. This study examines the impact of digital literacy of rubber smallholders in Monaragala district and the factors affecting it, focusing on the stand for sustainable trade of traceable input App, introduced by the Ksapa-led Rubber Improvement of value Chain and embedded smallholders resilience project in 2023. It was introduced to train farmers in sustainable rubber farming, enhance digital literacy, and promote compliance via a mobile platform. The sample was selected as a combination of stratified sampling and simple random sampling from a total population of 400 smallholders. Data was collected from 70 smallholders in the Monaragala district using a structured questionnaire and interviews. Socio-demographic factors, economic factors, digital literacy competencies, and cultivation practices were measured in the selected group and digital literacy was assessed on a 5-point Likert scale and categorized into high, moderate, and low levels using the equal interval concept. The analysis included descriptive statistics, correlation, and multiple regression analysis to identify key factors influencing digital literacy. Multiple regression showed that age, rubber income, education, and five digital competencies (accessing, managing, evaluating, utilizing and communicating agricultural information) significantly affect digital literacy among rubber smallholders in Monaragala. Age had a negative effect, while income, education, and digital skills had positive effects on the digital literacy level. It implies that farmers with higher income, education and stronger information competencies achieved a higher digital literacy level. The study concludes that digital literacy among rubber smallholders is at a moderate level. Limited smartphone access, poor network connectivity and lack of knowledge were identified as the main barriers to enhancing digital literacy among the rubber smallholders in Monaragala district.

Keywords: Digital Apps; digital communication; digital tool challenges; mobile platform; rubber yield



Paper ID: NSALS '26-177 (Oral)

A Study on Consumer Preferences and Willingness to Pay for Fruit-flavored Tea in Gampaha District

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Tea is one of the most popular beverages worldwide. In Sri Lanka, it holds significant cultural and economic importance. As lifestyles evolve and demand increases, value-added teas such as fruit-flavored, functional, and ready-to-drink options are gaining popularity. However, limited research has examined consumer preferences for fruit-flavored teas, with most existing studies focusing on conventional black tea consumption. This study aims to identify socio-demographic factors and sensory attributes influencing consumer preferences for fruit-flavored teas, examine product attributes that drive these preferences, and assess consumers' Willingness To Pay (WTP) in Gampaha district. A quantitative research design was applied, using purposive sampling to collect data from 200 consumers across Kelaniya, Wattala, and Gampaha divisional secretariat divisions in Gampaha district. Data were collected through a structured questionnaire. Consumer preference was measured using an ordered Likert scale rating, and data were analyzed using ordinal regression to examine the influence of socio-demographic factors and sensory attributes, Choice-Based Conjoint Analysis (CBCA) to evaluate product preferences, and a contingent valuation model to estimate WTP. Findings revealed that socio-demographic factors such as age, income, and education significantly influenced consumer preferences, while gender and occupation showed comparatively lower influence. Among sensory attributes, taste and aroma were the strongest drivers. CBCA results indicated that the most preferred product profile was lemon-flavored tea, packaged in a tin can, organic-certified, and priced at Rs. 1,200/pack. WTP analysis showed consumers were willing to pay an average of Rs. 918, with a median of Rs. 900, for 25 tea bags, which is higher than the average market price of standard black tea, indicating a willingness to pay a price premium for fruit-flavored tea. The study concludes that fruit-flavored tea has strong potential in the Gampaha district, especially among younger, educated, and higher-income consumers. The findings give practical guidance on suitable pricing strategies and highlight the growing opportunity for local producers to expand into the value-added tea segments.

Keywords: Choice-based conjoint analysis; ordinal regression analysis; product attributes; sensory attributes; socio-demographic factors



Paper ID: NSALS '26-189 (Oral)

Input Price Changes on Paddy Farmers' Profitability and Resource Allocation in the Irrigated System in Sri Lanka

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This study examines the impact of input price changes on the profitability and resource allocation of paddy farmers in the irrigated paddy cultivation system in Sri Lanka. The analysis employs the short-run restricted normalized translog profit function to estimate output supply and input demand responses jointly, using nationally representative data spanning 2000-2024 and covering both Maha and Yala seasons. The model incorporates key variable inputs such as labor, machinery, fertilizer, agrochemicals, and seeds, while treating land and machinery as fixed factors, consistent with short-run assumptions. The system of profit and cost share equations is estimated using seemingly unrelated regression (SUR), imposing theoretical constraints of homogeneity and symmetry. Descriptive analysis indicates that the cost of irrigated paddy systems is gradually rising, up to LKR 45,000/acre, while labor remains the major cost element at 33%. The farm gate paddy prices have been rising trend in recent years, which is partly as a result of inflationary pressures and adjustments to the government procurement prices. The results also indicate that profitability in irrigated paddy farming responds positively but inelastically to output price. Among inputs, machinery and labor costs exert the highest impact on profit and resource allocation, reflecting the relatively mechanized and input-intensive nature of irrigated systems. Own-price elasticities of input demand are generally inelastic, implying that farmers face structural and technological constraints in adjusting input use in response to price fluctuations. Cross-price elasticities reveal limited substitution possibilities between labor and machinery, highlighting rigidities in factor allocation despite rising labor costs. Fertilizer demand also exhibits low price responsiveness, indicating dependence on chemical inputs to sustain higher yields under irrigated conditions. These findings suggest that policies should be aimed at stabilizing input prices, particularly machinery operation costs and labor expenses, along with output price support mechanisms, which are crucial for improving income stability and production efficiency in irrigated paddy systems. Facilitating access to cost-effective mechanization and ensuring predictable price environments can enhance profitability without compromising production levels. This study contributes to the literature by providing an island-wide, post-crisis empirical assessment of irrigated paddy farmers' economic behavior in Sri Lanka, offering valuable insights for designing targeted and sustainable agricultural policies.

Keywords: Input price changes; irrigated paddy cultivation; profitability; resource allocation; Sri Lanka; translog profit function



Paper ID: NSALS '26-195 (Oral)

An Evaluation of Farmer Satisfaction with Radio and Web-based Radio Services Provided by the Department of Agriculture for Agricultural Knowledge Dissemination

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This study evaluates farmers' satisfaction with traditional radio and web-based radio services provided by the Department of Agriculture for disseminating agricultural knowledge in the Badulla district, Sri Lanka. The general objective was to evaluate overall satisfaction levels with these services, while specific objectives included identifying key influencing factors (content quality, accessibility, timeliness, relevance, interactivity, signal/internet availability, and demographic variables) and providing recommendations for improvement. Primary data were collected from a stratified random sample of 100 registered farmers (Welimada: 55; Bandarawela: 29; Passara: 16) using a structured questionnaire. Data were analyzed using descriptive statistics, Pearson correlation, reliability tests (Cronbach's Alpha), and separate multiple linear regression models for traditional radio and web-based radio services in STATA 15. Results showed moderate overall satisfaction with traditional radio services, driven primarily by strong signal quality ($\beta=0.672$, $P=0.000$), interactivity ($\beta=0.211$, $P=0.003$), availability ($\beta=0.131$, $P=0.034$), duration ($\beta=0.165$, $P=0.006$), broadcast frequency ($\beta=0.088$, $P=0.030$), content relevance ($\beta=0.142$, $P=0.032$), language suitability ($\beta=0.098$, $P=0.025$), and farming experience ($\beta=0.049$, $P=0.045$). In contrast, satisfaction with web-based radio services was lower, significantly influenced by accessibility, timeliness, interactivity, convenient scheduling, farming experience, and internet availability; however, female farmers, those with lower education, and livestock farmers reported significantly lower satisfaction. Awareness and utilization of web-based services remained low due to limited internet connectivity, digital literacy, and inadequate promotion. Farmers continued to rely heavily on traditional radio as their primary information source. The study recommends enhancing signal quality and interactivity in traditional broadcasts, expanding rural internet infrastructure, simplifying content for lower-educated users, incorporating gender and farming-type-specific programming, increasing interactive features, and better integrating traditional and digital platforms to improve overall knowledge dissemination effectiveness.

Keywords: Agricultural communication; farmer satisfaction; knowledge dissemination; rural radio; web-based radio services



Paper ID: NSALS '26-210 (Oral)

Tea Smallholders' Behavioral Intentions to Adopt Recommended Agricultural Practices in Tea Cultivation: A Case Study of Aruna Tea Factory in Passara

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Tea smallholders in Sri Lanka hold a significant place in the tea industry, contributing about 75% of tea production in the country. Poor adoption of recommended agricultural practices by tea small-holders leads the way for lower productivity, one of the significant issues of tea sector. Previous studies on the adoption of Recommended Agricultural Practices (RAPs) mostly tend to consider socio-economic characteristics and disregard core psychological factors influencing behavioral intention of farmers. This study aimed to evaluate three socio-psychological constructs, attitude, Subjective Norm, and Perceived Behavioral Control (PBC) of tea smallholders regarding recommended agricultural practices in tea, originating from the Theory of Planned Behavior (TPB), along with two proposed new constructs knowledge and moral norms. This study analyzed factors affecting the intention of tea smallholders of Aruna Tea Factory in Passara to adopt recommended agricultural practices, utilizing the Extended Theory of Planned Behavior Model (ETPBM). A sample of 100 registered smallholders was selected, and primary data were collected using questionnaires. The findings of this research provide evidence from the hierarchical regression analysis that the variables of ETPBM explain 6.3% more variation (change in R^2) in intention than the variables of TPB, while the socio-economic characteristics of farmers can explain only 2.1% more than the variables of ETPBM. The results indicated that farmers' subjective norms ($P < 0.001$) had the highest direct impact on intention to adopt RAPs. The findings showed that variables including subjective norms, attitudes, PBC, knowledge and moral norms are positively significant ($P < 0.001$) in understanding tea smallholders' intention to adopt RAPs. However, socio-demographic factors such as age, income, farming experience, and land size showed no significant influence ($P > 0.05$) on intention. This study provided evidence regarding the effectiveness of ETPBM when assessing the farmers' intention towards RAPs. In conclusion, the study shows that improving extension services can effectively shape tea smallholders' perceptions of RAPs in tea cultivation. By enhancing subjective norms around RAPs, we can significantly boost farmers' intentions to adopt these practices, ultimately supporting sustainable farming in the tea industry.

Keywords: Adoption; extended theory of planned behavior; knowledge; recommended agricultural practices; subjective norm; tea cultivation



Paper ID: NSALS '26-221 (Oral)

Export Competitiveness of Sri Lankan Tea: A Gravity Model Approach

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Tea is one of the major sources of export income in Sri Lanka. As one of the major converters of foreign exchange and rural revenue, understanding the determinants of tea export flows from Sri Lanka to its trading partners is crucial. Therefore, this study investigated the key determinants of tea export performance in Sri Lanka to its 15 large trading partners, namely USA, Russia, UAE, Syria, Saudi Arabia, Iran, Iraq, Pakistan, Japan, Jordan, Turkey, Lebanon, Kuwait, China, and India, during the period 2000-2023 by using the gravity model. Secondary data were obtained from the World Bank, International Trade Centre, Geographical Distance Dataset and Observatory of Economic Complexity. The model includes gross domestic product, population, exchange rate, tariff rate, and distance as independent variables, and the total tea export value is as the dependent variable in Sri Lanka and importing countries. The findings reveal that both the GDP of Sri Lanka and the GDP of importing countries significantly enhanced tea exports. A 1% increase in GDP in Sri Lanka, which averaged USD 58 billion during the study period, raised tea exports by approximately 0.71%, while a 1% increase in GDP in importing countries, averaging USD 2.4 trillion, increased exports by 0.30%. In addition, the large populations in importing countries, which rely on domestic tea industries, reduce exports in Sri Lanka. However, distance has an unexpectedly positive impact, possibly due to the strong brand reputation and high-value demand for Ceylon tea in distant premium markets. According to this analysis, exchange rates did not have a significant impact on export competitiveness, possibly due to the prevalence of auction-based pricing and long-term supply relationships that buffer short-term currency fluctuations. Tariff rates also showed no significant effect, as most importing countries apply low or zero import duties on Sri Lankan tea. This study suggests having trade negotiations and strategic market diversification to support economic growth in order to strengthen premium branding in distant markets and focusing on brand positioning rather than relying solely on tariff reductions and diversifying beyond traditional buyers and promoting value-added tea products such as organic, flavored and ready-to-drink varieties.

Keywords: Fixed effects; global market; gravity model; panel data; random effects



Paper ID: NSALS '26-232 (Oral)

Evaluating the Satisfaction of Farmers on Extension Services Provided by Coconut Cultivation Board (CCB) in Kegalle District, Sri Lanka

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The coconut industry is vital to Sri Lanka's agricultural economy, with extension services playing a key role in enhancing productivity and sustainability. This study assesses the satisfaction of coconut farmers with the extension services provided by the Coconut Cultivation Board (CCB) in Kegalle district. The general objective was to assess overall satisfaction levels, while specific objectives included identifying influencing factors and suggesting improvements. A stratified random sample of 100 registered coconut growers was selected proportionally based on cultivated land area from four divisions representing high, medium, and low production zones (Rambukkana, Deliwala, Yatiyanthota, Kegalle, and associated areas). Primary data were collected via a pre-tested structured questionnaire and analyzed using SPSS with descriptive statistics, Pearson's correlation, and multiple linear regression. Results indicated moderate satisfaction overall: 14% highly satisfied, 67% moderately satisfied, and 19% highly unsatisfied. Regression analysis ($R^2=0.931$, Adjusted $R^2=0.916$, $F=60.619$, $P<0.001$) showed that satisfaction was significantly positively influenced by frequency of officer visits ($\beta=0.272$, $P=0.043$), participation in training programs ($\beta=3.267$, $P=0.047$), service status of Coconut Development Officers ($\beta=0.196$, $P<0.001$), quality of extension services ($\beta=0.301$, $P<0.001$), and market and income satisfaction ($\beta=0.333$, $P<0.001$). Non-significant variables included experience in coconut cultivation, perceived economic benefits, effectiveness of training programs, understanding the suitability of services, participatory nature of services, and education level. Key issues identified from the study include limited access to updated information, poor farmer-officer communication, and low training participation. Recommendations include increasing officer field visits, diversifying and strengthening training programs with greater farmer involvement, establishing efficient feedback mechanisms, adopting digital tools for communication, and tailoring services to address income-related concerns. Future research could explore longitudinal impacts of improved extension services on productivity, compare satisfaction across districts, or assess the effectiveness of digital interventions in rural coconut farming.

Keywords: Coconut Cultivation Board ; coconut cultivation; extension services; farmer satisfaction; Kegalle district



Paper ID: NSALS '26-035 (Poster)

A Zero-waste Business Model for Sustainable Value Creation: The Case of Green Banana Naturals in Sri Lanka

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Plastic pollution and agricultural biomass waste present critical sustainability challenges in Sri Lanka, while underutilized indigenous resources remain economically neglected. This study adopts a qualitative case study approach to examine how a zero-waste business model can be developed using the *Musa acuminata* (banana) plant to generate sustainable value. The primary objective is to design and evaluate a zero-waste business model that converts all major components of the banana plant: fruit, flower, leaves, pseudostem, and fibers, into marketable products. The study employs a qualitative business analysis supported by secondary data review, prototype development, and market evaluation. Secondary data were collected from government agricultural reports, export statistics, sustainability policy documents, and published industry studies related to banana based products and circular economy practices. Prototype development involved mapping plant components to feasible product outputs based on existing technologies, material properties, and local processing capabilities. Market evaluation was conducted through desk-based analysis of consumer trends, sustainability driven demand, competitor offerings, pricing benchmarks, and export potential in selected local and international markets. Findings reveal a clearly defined zero-waste business model comprising four integrated product categories: (1) food and beverages (banana flour, chips, juice, jam, wine, and vinegar); (2) fashion and accessories (fiber based handbags and jewelry); (3) packaging and utensils (banana-leaf wraps, baskets, straws); and (4) arts and crafts (decorative and handmade products). The model demonstrates value creation through waste elimination, ethical sources from local farmers, and product diversification. Market analysis indicates growing demand among environmentally conscious consumers in Sri Lanka and selected international markets. Financial feasibility estimates suggest potential annual sales of LKR 24 million with a projected profitability ratio of 15.7%. The study concludes that a zero-waste, banana based business model can deliver measurable economic and environmental benefits while supporting circular economy objectives. As a case study, Green Banana Naturals offers a replicable framework for sustainable entrepreneurship in developing economies.

Keywords: Circular economy; eco-innovation; green entrepreneurship; sustainable business model; zero-waste approach



AGRICULTURAL ENGINEERING AND PROCESS TECHNOLOGY

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Paper ID: NSALS '26-004 (Oral)

Potential Use of Chlorinated Natural Rubber as a Compatibilizer in Natural Rubber/ Nitrile Butadiene Rubber Blends

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The blending of Natural Rubber (NR) with Nitrile Butadiene Rubber (NBR) is widely practiced, combining the excellent physico-mechanical properties of NR with the oil and chemical resistance of NBR; however, inherent incompatibility between the two polymers often limits their performance. This study investigates the effectiveness of Chlorinated Natural Rubber (CNR) as a compatibilizer in NR/NBR blends prepared at weight ratios of 70/30, 50/50, and 30/70. Powdered CNR was incorporated at loadings of 2.5, 5.0, 7.5, and 10 phr to enhance interfacial adhesion and phase compatibility. Fourier transform infrared (FTIR) spectroscopy indicated successful chlorination of NR through the appearance of characteristic C–Cl absorption ~ 650 cm. Cure characteristics, swelling and gel content, Dynamic Mechanical Analysis (DMA), and mechanical testing were employed to evaluate crosslinking behavior, network stability, compatibility, and performance. Swelling studies were conducted in toluene at room temperature for 72 h. Swelling decreased while gel content increased progressively with increasing CNR content across all blend ratios, indicating enhanced crosslink density and improved interfacial interactions, with the most pronounced effect observed for the NR/NBR (70/30) composition. DMA results revealed systematic shifts of the glass transition regions toward each other with CNR incorporation, accompanied by reduced $\tan \delta$ peak intensity and separation, as well as increased storage modulus in the rubbery region. These trends indicate improved phase interaction and restricted molecular mobility rather than simple multiphase behavior. Among all formulations, the NR/NBR (70/30) blend containing 10 phr CNR exhibited the most balanced compatibilization response. This optimized blend (70/30/10) showed a hardness of 84 IRHD, a cure time (T_{c90}) of 9.96 min, a tensile strength of 6.97 MPa, and a tear strength of 58.03 N/mm. The comparatively lower tensile strength despite high hardness and gel content is attributed to increased polarity and crosslink density, which restricts chain extensibility and limits strain-induced crystallization of NR. Overall, the results demonstrate that CNR is an effective compatibilizer for NR/NBR blends, improving compatibility, structural integrity, and thermo-mechanical performance. These findings highlight the potential of CNR as a potentially cost-effective and sustainable compatibilization approach for industrial rubber applications.

Keywords: Blend compatibility; chlorinated natural rubber; dynamic mechanical analysis; mechanical properties; natural rubber; nitrile butadiene rubber



Paper ID: NSALS '26-014 (Oral)

Effect of Titanium Dioxide Grafted Expandable Graphite on the Flame Retardant Performance of Natural Rubber Foam Composites

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Titanium Dioxide Grafted Expandable Graphite (TiO₂-g-EG) is a halogen-free, environmentally friendly flame-retardant ingredient that could be used in Natural Rubber ILatex (NRL) foam composites for flame-retardant applications. NRL foam composites are demanded for their health benefits, but they require flame-retardant actions due to their inherent flammability. Conventional flame-retardant materials often contain halogenated chemicals that pose significant risks to human health as well as the environment. This study addresses this challenge by synthesizing TiO₂-g-EG as a sustainable alternative. Therefore, this study focused on developing TiO₂-g-EG-filled NRL foam composites that have better flame-retardant properties. The research employs advanced analytical techniques, including X-Ray Diffraction and Fourier Transform Infrared Spectroscopy, to characterize the TiO₂-g-EG. NRL foam composites were prepared with various loadings of TiO₂-g-EG to assess optimum incorporation loadings for enhanced flame retardancy of the foam composites. Results indicated that TiO₂-g-EG effectively enhanced the flame retardancy by prolonging ignition time and formation of char layers during combustion. With increasing TiO₂-g-EG loading, it decreased the time taken to extinguish the flame. One-way ANOVA showed a significant effect on elongation at break ($P=0.026$), while all other evaluated properties, including density, tensile stress, tear strength, gel time, water absorption, and shrinkage, had P -values reported as 0.000. Therefore, all the P -values were less than the significance level ($P<0.05$), which confirmed that the incorporation of TiO₂-g-EG significantly affected the physical and functional properties of the produced foam composites. Densities of TiO₂-g-EG loaded foam composites increased, and gel times and water absorptions decreased, while other evaluated properties didn't show any clear variation when increasing TiO₂-g-EG loadings. This research contributes to the development of environmentally friendly halogen-free flame-retardant ingredients for natural latex foam composites, advancing scientific knowledge in latex technology and offering potential benefits for safer and more sustainable sleep products.

Keywords: Flame retardancy; grafted expandable graphite; natural rubber latex foam; titanium dioxide



Paper ID: NSALS '26-030 (Oral)

Analysis of Soil Erosion Potential in Victoria Reservoir Catchment of Sri Lanka using GIS Techniques

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Victoria Reservoir is one of Sri Lanka's most important hydroelectric facilities and also provides irrigation and water supply to downstream areas. The catchment, located over the central highlands and covering approximately 1,311 km², is highly susceptible to erosion due to steep slopes, high precipitation, and intensive farming practices. This study analyzes the morphometric properties of the Victoria reservoir catchment using GIS tools to determine its hydrological behavior and potential for soil erosion. Rather than applying empirical erosion models, this study evaluates erosion susceptibility based on morphometric controls on runoff generation and terrain relief at the catchment scale. A 30 m ASTER DEM and ArcGIS 10.8 hydrology tools were used for drainage network delineation and calculation of morphometric parameters under linear, area, and relief aspects. Stream order, stream frequency, drainage density, form factor, elongation ratio, basin relief, and ruggedness number were estimated to define hydrological attributes influencing erosion and runoff dynamics. The results indicate that the dendritic drainage pattern reaches up to the 7th Strahler order, representing a well-distributed and strong river network. The basin shows moderate drainage density (2.35 km/km²) and high stream frequency (3.79), indicating effective surface runoff accumulation. The average length of overland flow is 0.21 km, suggesting a fast concentration of surface runoff. Areal indices indicate an irregularly shaped basin with a form factor of 0.72 and a compactness coefficient of 2.46, which may contribute to rapid inflow peaks. The analysis of relief aspects reveals basin relief of 1,725 m, a relief ratio of 0.041, and a ruggedness number of 4.058, which indicates the presence of steep slopes and high erosion susceptibility. These findings indicate that the Victoria catchment is an active mountain watershed with high susceptibility to soil erosion and sediment transport and provide a baseline for future sub-catchment prioritization. Therefore, implementing enhanced catchment conservation and management strategies is essential to protect the Victoria reservoir from silting and ensure its long-term sustainability.

Keywords: ASTER DEM; catchment conservation; erosion susceptibility; morphometric analysis; runoff dynamics



Paper ID: NSALS '26-036 (Oral)

Design and Develop a Portable and Semi-automated Seeding Machine for Greenhouse Nurseries

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Greenhouse nurseries involve high costs for nursery management, particularly due to manual seed sowing, which is time-consuming, labor-intensive, and often inconsistent when handling large numbers of seed trays. To overcome these limitations, this study aimed to design and develop a portable and semi-automated seeding machine suitable for small- and medium-scale greenhouse nurseries. The machine was modeled using SolidWorks and validated through numerical analysis, confirming low torque and force requirements, which enabled the use of low-power electric motors and improved energy efficiency. The fabricated prototype has compact dimensions of 1050×350×300 mm, weighs approximately 12 kg, and was constructed with a mild steel frame featuring a conveyor-driven soil and seed distribution mechanism. Its compact configuration enhances portability and allows efficient operation within restricted greenhouse environments. The conveyor-based system integrates two main functional units: a soil distributor and a seed distributor. During operation, the conveyor transports nursery trays beneath the soil distributor for uniform filling, followed by controlled seed dispensing through the seed distributor, and finally a thin soil covering layer to ensure proper seed placement. Performance evaluation was conducted using standard nursery trays, with one seed/cell, over 10 replicated trials, each involving 10 trays that consist of 35 cells. Manual sowing enables a worker to prepare approximately 14 trays per hour, whereas the developed machine processes up to 112 trays/hour, achieving an approximately 88% reduction in planting time/tray. This improvement demonstrates enhanced operational efficiency and consistency while reducing labor demand, seed wastage, and operator fatigue. Overall, the proposed machine introduces a compact, multifunctional, and low-power automation solution for greenhouse nurseries, supporting precision seeding and improved productivity. Future work will focus on performance optimization and the integration of sensing and control technologies.

Keywords: Greenhouse automation; greenhouse nursery; precision agriculture; seed planting



Paper ID: NSALS '26-038 (Oral)

Assessment of Land Cover Changes and Climate Factors influence on Coconut Productivity in the Coconut Triangle, Sri Lanka

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Coconut cultivation represents one of Sri Lanka's most significant agricultural enterprises. The Coconut Triangle, which includes the districts of Kurunegala, Puttalam, and Gampaha, covers more than 70% of the country's total coconut cultivation across 1,095,982 acres. Changes in rainfall patterns, temperature extremes, and shifting seasons added stress conditions to cultivation. Coconut production significantly declined by 24% during the month of October 2024, which has increased coconut prices and raised concerns among agricultural policymakers and farming communities. No study has simultaneously quantified land cover and climate influences on coconut yield using multi-source geospatial data in this region. This study aimed to identify spatial and temporal patterns of land cover changes and climate factors on coconut productivity during 2019–2024 in the Coconut Triangle, Sri Lanka. Sentinel-2 Level-2A Surface Reflectance imagery, Moderate Resolution Imaging Spectroradiometer Terra, Land Surface Temperature (LST) data, Global Precipitation Measurement datasets, and annual coconut production statistics were used for the analysis. Random forest classification was conducted based on normalized difference vegetation index, enhanced vegetation index, soil-adjusted vegetation index, and red-edge NDVI. Random forest classifier was validated using an 80% training and 20% testing ratio, with training data collected through visual interpretation of high-resolution imagery and ground truth sources. Land cover classification achieved high accuracy (97.4–98.3%; Kappa coefficient=0.95–0.97). Coconut area declined by 6.43% (309,364 to 289,452 ha), averaging a loss of 3,982 ha/year. Annual rainfall showed strong variability [1,573 mm (2020)–2,398 mm (2023)], while mean annual LST decreased from 30.65°C (2019) to 29.34°C (2024), likely due to land cover changes and regional climate influences. Correlation analysis over the six years showed that rainfall variability ($r=0.18$) had a weak positive short-term influence on yield, and coconut land area decline ($r=-0.964$) exhibited a strong negative long-term impact. These findings highlight the need for integrated land-use planning, water management, and climate-resilient coconut varieties to support evidence-based policy interventions for the sustainable development of Sri Lanka's coconut industry.

Keywords: Climate factors; coconut production; land cover changes; rainfall pattern; random-forest classification



Paper ID: NSALS '26-040 (Oral)

Formulation of Slow-release Fertilizer and Measuring its Effectiveness on Nursery Tea (*Camellia sinensis*) Plants

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Fertilizer application is a standard management practice in tea cultivation, and it greatly influences the tea yield and productivity. Overuse of chemical fertilizers can lead to environmental issues like soil acidification and water pollution with phosphorus (P) and nitrogen (N). Numerous studies have been conducted to identify the effectiveness of Slow-Release Fertilizers (SRFs). However, limited studies have been conducted on the development and testing of compound SRFs for tea nursery plants. This study aimed to formulate a slow-release nano-fertilizer, determine its physicochemical properties, and test the formulated fertilizer on nursery tea plants. Nano-bentonite was blended with T65 fertilizer at different N levels, and four types of fertilizers were formulated: T1-1:0.5 (50% reduced N), T2-1:0.75 (25% reduced N), T3-1:1 (standard N), and T4-1:1.25 (25% increased N). All four SRFs and T65 fertilizer (T5) were applied at the rate of 0.3 g of N per plant, along with a control group that received no fertilizer (T6). Eight replicate nursery plants (TRI 4053) for each treatment were arranged in a completely randomized design. The formulations were characterized using Fourier Transform Infrared Spectroscopy (FTIR) to examine chemical bonding and Differential Scanning Calorimetry (DSC) to evaluate thermal stability. Growth parameters, including shoot height, leaf count, chlorophyll content, root length, root distribution, and shoot and root dry weight, were recorded. ANOVA results showed that T1 to T4 formulations had N content ranging from 4.70 to 7.84%. FTIR analyses showed interactions between T65 fertilizer and bentonite clay. DSC analyses showed better thermal stability in SRFs than T65. Greenhouse trials demonstrated that slow-release fertilizer treatments, especially T4, significantly ($P < 0.05$) increased shoot height, leaf count, root development, and dry matter yield, compared to both the control (T6) and the conventional T65 fertilizer (T5). These findings suggest that bentonite-based SRFs can be used to improve nutrient utilization efficiency and reduce nutrient losses. Further research is merited with more replicates to validate this finding.

Keywords: Nano-bentonite; nutrient efficiency; slow-release fertilizer; tea nursery plants; T65 fertilizer



Paper ID: NSALS '26-046 (Oral)

Machine Learning-based Coconut Tree Detection and Counting Using High-resolution Satellite Images in Kurunegala District

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Coconut (*Cocos nucifera*) is a major plantation crop in Sri Lanka. The conventional field-based surveys for tree counting are labor-intensive, costly, time-consuming, and limited in large scales. The availability of very high-resolution satellite imagery and advanced deep learning techniques provides new opportunities for precise tree detection and counting at regional scales. This method offers an efficient alternative to costly field-based surveys. Therefore, this study was conducted to detect and count coconut trees across Kurunegala district, a main coconut cultivating district, using You Only Look Once (YOLO) based object detection models by using high-resolution Google Earth images. A 150 dataset of 0.15 m spatial resolution satellite images was manually annotated, yielding 30,843 bounding-box labels, and expanded through augmentation to improve generalization. The dataset was divided into clear, blurry, boundary-edge imagery, and a combined dataset. Different variants (n, s, m and l) of YOLOv8 and YOLOv11 models were trained under 200 epochs, and a batch size of 4, and their performances were evaluated using precision, recall, F1-score, and mean average precision at 50% IoU (mAP50). Results demonstrated that the compact YOLOv11s provided the best accuracy and efficiency for the whole dataset, achieving 0.943, 0.743, 0.831, and 0.833 of precision, recall, F1, and mAP50, respectively. Accuracy for clear imagery, blurred/cloudy imagery, and boundary-edge imagery was 99.92%, 75.03%, and 97.04%, respectively. The best model was deployed on 89,459 images that covered the entire Kurunegala district to count the total number of coconut trees, and it was found as 15,958,089. The dense canopy overlaps, and image quality was the primary cause of miss-classification. The findings highlight the effectiveness of deep learning-based models for the detection of large trees like coconut on a large scale and demonstrate the potential of this approach as an effective, scalable, and timely solution for supporting plantation management, resource allocation, and policy decision-making in Sri Lanka.

Keywords: Coconut tree detection; deep learning; Kurunegala district; remote sensing; YOLO



Paper ID: NSALS '26-050 (Oral)

Investigating the Correlation between the Sensory Attributes and Chemical Profiles of Selected Tea Blends

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Tea (*Camellia sinensis*) is a beverage with a tendency to be consumed in most countries in the world, and the quality of tea is tightly bound to the chemical composition, which immediately affects the aspects of sensory features. Traditional techniques of tea grading and quality evaluation are mainly sensory and, therefore, are subjective and may not be consistent across blends and regions. The study aimed to establish correlations among chemical profiles and sensory attributes of eight commercial tea blends made using Ceylon tea from different agro-ecological zones. Which includes Uda Watte (High Grown), Meda Watte (Mid Grown), Yata Watte (Low Grown), Ran Watte (Nuwara Eliya), English Breakfast (Western High Grown), English Afternoon (Bogawantalawa), Flavored Tea Base (Uva, Uda Pussellawa, and Nuwara Eliya), and Ceylon Supreme (Dimbula and Maskeliya). The samples were tested in terms of antioxidant activity, total polyphenols, caffeine level, and the ratio of theaflavins (TF), thearubigins (TR), using conventional analytical procedures. A trained panel of seven tasters conducted sensory evaluation on a nine-point hedonic scale, evaluating such characteristics as aroma, darkness, bitterness, astringency, liquor color, and overall acceptability. ANOVA was used as a form of statistical analysis, after which the means of different variables were compared, and a Pearson correlation was conducted at a significance level of 0.05. The findings showed that tea blends of the Watte regions and especially Yata Watte and Meda Watte, had the highest antioxidant activity, ranging between 156.54 ± 25.32 and 148.07 ± 17.07 ppm of ascorbic acid equivalents, respectively. The caffeine was found to range between 1.82% and 2.70% and exhibited a positive and significant correlation with perceived bitterness ($r=0.62$). The liquor strength and body were positively related to the total polyphenol content ($r=0.71$). Besides, the TF:TR ratio had a high positive correlation with the brightness and total acceptability, which reveals the significance of this approach in sensory quality perception. Chemical profiling and sensory analysis would help enhance consistency, standardization, and value-based grading of the Sri Lankan tea industry.

Keywords: Antioxidant activity; caffeine content; *Camellia sinensis*; polyphenols; sensory attributes; TF:TR ratio



Paper ID: NSALS '26-062 (Oral)

Study of the Degradation Behavior of Natural Rubber Latex Incorporated with Rice Husk Cellulose Nano Crystals

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The management of rubber waste is one of the biggest challenges due to the complexity of rubber/latex-based products, which are resistant to degradation in the environment compared to other polymers. Single-use Natural Rubber Latex (NRL) products like disposable gloves produce significant solid waste; the COVID-19 pandemic has intensified this waste issue. Therefore, the combination of the rubber system with the biomaterial is a feasible option. This study focused on investigating the impact of Rice Husk Cellulose Nano Crystals (RHCNC) incorporation on the biodegradation behavior of NRL films, to identify the optimal concentration of nanocellulose for enhanced degradation, and to evaluate the mechanical properties of RHCNC-modified NRL films. Cellulose was successfully extracted from rice husk and hydrolyzed into Cellulose Nano Crystals (CNC) with an average crystalline size of 3.2 nm, confirming the nanoscale range. The RHCNC dispersion was incorporated with NRL at different concentrations (1-5 phr) and characterized using Fourier transform infrared spectroscopy and X-ray diffraction techniques. Biodegradation was evaluated through soil burial tests, swelling index, and extractable protein content, while physico-mechanical properties were evaluated using tensile and tear strength tests. Statistical analysis using Two-way ANOVA for biodegradation test results revealed that nanocellulose incorporation into the NRL significantly influences the degradation behavior of NRL ($P=0.000$). Among the tested samples, the 5 phr RHCNC incorporated sample showed the highest mean weight loss percentage (12%), while all RHCNC incorporated films showed statistically significant difference compared to the NRL sample. Physico-mechanical analysis revealed that CNC incorporation improved the tensile strength compared to NRL film, with the highest tensile (27.5 MPa) and tear strength (54.4 N/mm) observed in the 5 phr sample. After one month of soil burial, a reduction of mechanical properties was observed (lowest tensile 24.6 MPa; tear 49.3 N/mm in 4 phr sample), indicating enhanced biodegradation. Incorporation of RHCNC into NRL is proven to accelerate the biodegradation of latex films, with 5 phr identified as the most effective concentration under the tested conditions.

Keywords: Biodegradation; natural rubber latex; rice husk cellulose nano crystals



Paper ID: NSALS '26-069 (Oral)

A Preliminary Study on a Safer Secondary Preservative Strategy for Natural Rubber Field Latex

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Natural Rubber Latex (NRL) putrefies and coagulates shortly after harvesting. Therefore, preservatives are added to stabilize NRL before it arrives at the processing factory. The widely used tetramethylthiuram disulfide/zinc oxide (TMTD/ZnO) preservative system presents risks of nitrosamine formation, while high-ammonia preservation practices are associated with elevated ammonia emissions, creating occupational and environmental concerns. This study aimed to investigate an alternative preservative system with the potential to replace TMTD/ZnO while reducing nitrosamine formation and minimizing ammonia usage. A tertiary amine-based organic compound (TA) combined with zinc sulfate ($ZnSO_4$) as a secondary preservative system with low ammonia (0.3%) was evaluated in this study. Natural field latex samples were treated with varying concentrations of TA/ $ZnSO_4$ at low ammonia concentrations (0.2% and 0.3%) across four trials. The buffering capacity, metal-chelating characteristics, and surfactant-like qualities of TA collectively contribute to colloidal stability. TA is characterized by low acute potential for nitrosamine formation and is widely regarded as safe for controlled industrial use. $ZnSO_4$ exhibits inhibitory effects on microbial activity and associated enzymatic degradation in NRL. Preservation efficacy was assessed by monitoring Volatile Fatty Acid (VFA) number and pH variation over storage time. Latex formulations preserved with 0.3% ammonia + 0.5% and 0.7% TA + 0.03% $ZnSO_4$ exhibited VFA number trends closely comparable to the control system (0.3% ammonia + 0.025% TMTD/ZnO) over 16 days of storage. Although numerical differences in VFA values among treatments were minimal, statistical analysis indicated a significant influence of preservative system, storage duration, and their interaction on VFA number ($P < 0.05$). Throughout the storage period, pH remained within a narrow alkaline range of 9.80-10.29 across the aforementioned treatments, indicating a stable preservation environment. The relatively small variations in VFA observed in the developed systems indicate that latex stability during short-term storage is comparable to that of the conventional secondary preservative system, while potentially reducing the risk of nitrosamine formation.

Keywords: Low ammonia preservation; natural rubber field latex; nitrosamines; pH; TMTD/ZnO system; volatile fatty acid number



Paper ID: NSALS '26-071 (Oral)

Effect of Skim Rubber Incorporation on the Physico-mechanical and Quality Characteristics of Technically Specified Rubber

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Technically Specified Rubber (TSR) production in Sri Lanka is constrained by raw material shortages, processing inefficiencies, and variability in quality. To maintain supply and meet diverse customer requirements, rubber manufacturers often blend TSR with other grades of rubber, like RSS or skim. Skim rubber, a by-product of latex centrifugation, contains a considerable proportion of non-rubber constituents (processed skim rubber generally contains 75–85% rubber hydrocarbon, 9–18% protein, and 5–10% acetone-soluble materials), and is underutilized or treated as a low-value material with blending potential. This study investigates the influence of skim rubber incorporation on the properties of TSR, which addresses a significant knowledge gap in blending practices. Rubber blends were prepared using varying ratios of TSR 20 to skim rubber (6:1, 5:2, 4:3, 3:4). The effect of skim addition on the raw rubber quality parameters and physico-mechanical properties was evaluated through standardized ISO testing procedures. One-way ANOVA and mean comparison (Tukey) were carried out to compare samples. Results revealed that increased skim rubber content significantly ($P < 0.05$) affected the chemical, physical, and mechanical attributes of the blends. Notably, the nitrogen content ($0.30 \pm 0.009\%$ to $0.57 \pm 0.003\%$), acetone extract content ($1.49 \pm 0.08\%$ to $2.63 \pm 0.11\%$), and volatile matter content ($0.47 \pm 0.009\%$ to $0.60 \pm 0.009\%$) increased proportionally with skim rubber incorporation due to its protein-rich constituents, while dirt content declined from $0.27 \pm 0.014\%$ to $0.05 \pm 0.013\%$, suggesting improved cleanliness in blends. These non-rubber components negatively influenced the plasticity retention index (from 67.13 ± 0.46 to 5.93 ± 1.05) in the raw rubber, indicating reduced oxidative stability. When comparing mechanical properties, notably tensile strength decreased from 23.57 ± 0.17 MPa to 10.05 ± 0.40 MPa. Among tested blends, 4:3 ratio of TSR20 to skim blend demonstrated comparable performance to pure TSR20 grade on mechanical properties, whereas tear strength improved notably at 75.87 N/mm. The 4:3 blend also exhibited balanced hardness (54.6 ± 0.34 IRHD), compression set ($13.75 \pm 0.24\%$), swelling index ($163.77 \pm 0.63\%$), and abrasion (0.146 ± 0.006 mm³) properties comparable to the TSR20 at 0.05 significance level. These findings suggest that skim rubber can be effectively used to tailor the properties of TSR for specific applications.

Keywords: Physico-mechanical properties; raw rubber quality characteristics; skim rubber; technically specified rubber



Paper ID: NSALS '26-105 (Oral)

Development of a Sustainable Composite Board Utilizing Reclaimed Rubber, Recycled PET Plastic Fibers, and Coir

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The rapid increase in rubber and plastic waste has created significant environmental challenges, while natural fibers such as coconut coir remain underutilised. This study focused on developing a sustainable composite board by incorporating Reclaimed Rubber (RR), recycled polyethylene terephthalate (PET) fibers, and coir. Different formulations were prepared by varying the ratio of RR to PET fibers [RR: PET were 100:0 (S1–control), 70:30 (S2), 60:40 (S3), 50:50 (S4), and 40:60 (S5)], while maintaining a fixed 10 phr coir content. Compounds were mixed using a two-roll mill and vulcanised using a compression moulding machine. The chemical structures were examined by Fourier Transform Infrared Spectroscopy (FTIR) for each formulation, and physico-mechanical properties such as tensile strength, tear strength, hardness, abrasion resistance, and flexural strength were tested according to ISO standards. Results highlighted that the addition of PET fibers improved reinforcement, enhancing tensile strength, hardness, and flexural strength. Among the samples, S5 showed significantly ($P<0.05$) higher tear strength of 15.67 MPa and flexural strength of 5.09 MPa. Further, the tensile strength (1.77 MPa) is comparable with the control sample, and the hardness (98.7 IRHD) is comparable with other samples. However, abrasion loss was significantly ($P<0.05$) greater than that of the control sample. Nonetheless, for a composite board, abrasion loss is not a primary parameter; therefore, it isn't crucial to consider. FTIR analysis confirmed the successful blending of reclaimed rubber, PET, and coir. Findings suggest that the PET and coir mixture has the potential to be used with rubber for preparing composite boards. The research highlights a sustainable approach to converting waste materials into value-added products, contributing to environmental conservation and cost-effective material development. Future work will focus on experimentally evaluating novel additive formulations to reduce abrasion loss.

Keywords: Coconut coir; composite board; PET fibers; reclaimed rubber; recycled plastic



Paper ID: NSALS '26-110 (Oral)

Simulation-based Preliminary Design and Analysis of a Forking Machine for Loosening Compacted Tea Field Soils

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Soil compaction in tea lands reduces yield and soil health due to recurring field operations, human traffic, and poor soil management practices. Currently, manual forking is used to loosen compacted soil; however, it is labor-intensive, inefficient, and increasingly unsustainable due to labor shortages in the plantation sector. Despite the availability of general tillage studies, no simulation-based design studies have specifically addressed a forking machine tailored to the geometric, soil, and operational constraints of tea cultivation. The present study aimed to develop and evaluate a simulation-based preliminary design of a dual-purpose forking and rotary tillage machine intended for soil decompaction in tea fields. The research methodology combined field observations, Computer-Aided Design (CAD) modeling, Discrete Element Method (DEM) based soil machine interaction analysis, and structural validation using Finite Element Analysis (FEA). It should be noted that the study is limited to numerical simulations, and no physical prototype fabrication or field validation was conducted at this stage. The mechanism was modeled in SolidWorks 2023 with two subsystems. A tine-based forking mechanism for vertical penetration and a rotary blade mechanism for lateral soil churning and shear layer fracture. The CAD models were exported to Altair EDEM 2023, where Red Yellow Podzolic and Reddish Brown Earth soil beds were generated using literature-based physical and mechanical properties, including density, shear modulus, Poisson's ratio, and friction coefficients. Simulations quantified total contact force, pressure distribution, torque, and energy consumption. Simulation results indicated draft force requirements of 12–18 kN for the tine and 4–6 kN for the rotary blade, which are consistent with reported values in related soil-engaging tool studies. Optimal simulated performance occurred at a backward speed of 0.5 m/s, tine speed of 36 rpm, and blade speed of 270 rpm. FEA results showed a maximum Von Mises stress of 47.6 MPa, well below the yield strength of alloy steel (≈ 620 MPa), corresponding to a safety factor of 15. In conclusion, this study demonstrates the feasibility of using simulation-based approaches for the preliminary design and optimization of soil-loosening machinery. However, the findings remain theoretical until validated through prototype development, controlled field trials, economic assessment, and comparison with existing soil-loosening practices.

Keywords: Altair EDEM 2023; DEM simulation; forking machine; soil loosening; SolidWorks 2023; tea cultivation mechanization



Paper ID: NSALS '26-118 (Oral)

Improving the Quality of Palmyra (*Borassus flabellifer* L.) Fruit Fiber for Textile Yarn Production

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Palmyra fruit fiber is an underutilized natural fiber that is generally unsuitable for yarn production due to its coarseness, uneven structure, high lignin content, limited flexibility, and lack of fineness required for spinning smooth and continuous threads. Previous studies have concentrated on Palmyra leaf or sheath fibers, reporting only partial mechanical property improvements and inadequate optimization of treatment conditions for fruit fibers. Ripe palmyra fruits were processed, and the fibers were manually extracted, which were then treated with four different chemical solutions in 5% concentration: sodium hydroxide (NaOH), hydrochloric acid (HCl), citric acid, and magnesium chloride (MgCl₂) at various soaking times with room temperatures ranging from 3–7 hours. The effects of these treatments on fiber quality were evaluated using tensile strength testing, morphological analysis, and Fourier Transform Infrared Spectroscopy (FTIR). Statistical significance was determined using ANOVA followed by the Tukey test. NaOH treatment for 5 and 6 hours was significantly higher ($P < 0.05$) than the 4-hour treatment. Exposure to HCl and citric acid for different time intervals did not significantly improve the tensile strength. However, the tensile strength of MgCl₂ treatment showed a decreasing trend. Tensile strength of MgCl₂ exposure for 7 hours showed significantly lower ($P > 0.05$) tensile strength than the 3-hour treatment. For NaOH treatment, the fiber width continuously decreased with exposure time. NaOH treatment for 5 to 6 hours produced the best fiber quality, with improved tensile strength (up to 162 MPa) and reduced fiber diameter (down to 36 μm). FTIR analysis demonstrated successful elimination of non-cellulosic components post-NaOH treatment, indicated by diminished lignin peaks ($\sim 1730/\text{cm}$ and $\sim 1240/\text{cm}$) and more defined cellulose bands ($\sim 1030/\text{cm}$ and $\sim 3330/\text{cm}$), correlating with enhanced mechanical performance.

Keywords: Palmyra fruit fiber; softening agents; sustainable textile production; tensile strength



Paper ID: NSALS '26-127 (Oral)

Biotower-based Novel Cosmetic Wastewater Treatment using Wood Apple (*Limonia acidissima*) Shell Biochar

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A rising number of contaminants have been released into the environment as a result of the increased usage of cosmetic goods, which might be dangerous for both the environment and human health. In recent years, Biotowers have emerged as a promising technology for removing various pollutants, including those derived from cosmetics. This work aims to provide insights into the mechanisms underlying the efficient removal of cosmetic pollutants using biotowers and discuss the environmental implications of this technology. In this work, wood apple (*Limonia acidissima*) shells were utilized to make biochar, which was produced by pyrolysing the shells at 350°C for 3 hours. The characteristics and adsorptive capabilities of the subsequently formed biochar were examined. The carbon arrangement and the mineral quality of a biochar were clearly revealed by X-ray diffraction analysis. Sand, charcoal, zeolite, and yeast were employed as filter materials. By analyzing the water quality metrics before and after the filtering process, the ability of the biotower with various filter materials to remove pollutants was examined. All the mentioned filter materials were examined individually and combined within the biotower. Among them combination of all materials arranged as layers that initiate from the zeolite layer, then the sand layer, and the Biochar layer, recorded the best results that met the irrigation water quality standards. Color, turbidity, total dissolved solids, total solids, biochemical oxygen demand, and chemical oxygen demand of the synthetic influent were significantly decreased, and the effluent showed a statistically significant difference in all evaluated parameters ($P < 0.05$), as 92.98%, 63.46%, 56.83%, 67.16%, 92.93%, and 90.13%, respectively. The results of the study revealed that biochar made from wood apple shells had positive results on the removal of cosmetic pollutants because of its higher adsorptive ability. The innovative method provides an economical and environmentally benign method for the treatment of wastewater with cosmetic pollutants.

Keywords: Adsorption; biochar; cosmetics pollutants; pyrolysis; wastewater; wood apple shell



Paper ID: NSALS '26-140 (Oral)

Intelligent Weed Detection and Precision Chemical Spraying in Paddy Fields Using YOLOv12

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Weed infestation in paddy fields remains a major agricultural challenge that negatively impacts crop yield, production efficiency, and environmental sustainability. Conventional weed management practices, such as manual weeding and blanket pesticide application, are labor-intensive, time-consuming, and often lead to excessive chemical use, increasing production costs and environmental pollution. To address these limitations, this research aims to develop an intelligent automated system for accurate weed detection and selective herbicide spraying in paddy fields, thereby optimizing chemical usage and improving crop productivity. To achieve this objective, a deep learning-based weed detection framework using You Only Look Once version 12 (YOLOv12) was designed and implemented. The proposed system processes real-time images captured from paddy field environments and performs object detection to distinguish rice crops from weeds. The model was trained to identify grass weeds and broadleaf weeds, along with the rice crop class. The training dataset consisted of annotated images collected under varying lighting conditions, growth stages, and field environments to ensure robustness and generalization capability. Performance evaluation of the trained YOLOv12 model achieved a mean Average Precision of 95.6%, demonstrating reliable discrimination between weed classes and rice plants. Based on the detection output, an automated control unit was integrated with a selective spraying mechanism that applies herbicide exclusively to detected weed locations. Experimental trials conducted under controlled field conditions showed an improvement in spraying accuracy of about 85% compared with conventional uniform spraying methods. The results confirm that integrating deep learning-based vision systems with automated selective spraying mechanisms offers a sustainable solution for weed control in paddy fields. The proposed approach minimizes chemical usage, reduces crop exposure to herbicides, and improves operational efficiency. This study contributes to precision agriculture by presenting a scalable, cost-effective framework for weed detection and targeted spraying applications.

Keywords: Deep learning; paddy field; precision agriculture; selective spraying; weed detection; YOLOv12



Paper ID: NSALS '26-152 (Oral)

Effect of Altheon Foliar Spray on Green Leaf Yield and Polyphenol Content in Black and Green Tea: A Study on Vegetative vs. Seedling Tea at Demodara, Sri Lanka

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Tea (*Camellia sinensis* (L.) O. Kuntze) is a perennial crop appreciated for its tender foliage containing polyphenols, catechins, and caffeine that are important determinants of the quality of tea and its health benefits. Foliar fertilization can facilitate increased nutrient uptake and influence plant growth and biochemical composition. The objective of this study was to evaluate the effect of the graphene oxide-based foliar fertilizer called Altheon on green leaf yield and Total Polyphenol Content (TPC) in Vegetatively Propagated (VP) and Seedling-Derived (SD) tea at Demodara Estate, Sri Lanka. The study comprised three VP and two SD blocks; each block was divided into 1 ha Altheon-treated plot and 1 ha control plot. Altheon solution, presented in combination with zinc, urea, and magnesium sulphate, was spray-applied uniformly. Shoots with one bud and two leaves were harvested and then made into black and green tea products. TPC was analyzed following the Folin-Ciocalteu (ISO 14502-1:2005) methodology in triplicate. A two-way ANOVA with Tukey HSD test was performed. The Altheon application resulted in a significant ($P<0.05$) increase in the TPC for both types of tea. The TPC of green tea rose to 23.49 mg GAE/g in Altheon-treated plants, whereas the control had a TPC of 18.70 mg GAE/g; specifically, VP plants exceeded SD in TPC. It established a significant ($P<0.05$) effect of Altheon on green tea plants. Similarly, black tea also showed similar trends, with VP plants producing TPC at 14.85 mg GAE/g versus 9.30 mg GAE/g in SD. Cumulatively, the green leaf yield also increased markedly following Altheon application. VP plots produced yields up to 2,524 g compared to 940 g in the control, while SD plots increased from 502–699 g to 1,650–1,859 g. Statistical analysis revealed that both foliar treatment ($P=0.000$) and propagation type ($P=0.018$) had a significant effect on tea yield. The findings indicate that Altheon increases tea output and total phenolic content primarily via enhancing foliar nutrient absorption and plant biochemical efficiency, with a more significant impact noted in vegetatively propagated specimens. This finding highlights Altheon's potential as an effective foliar fertilizer for improving the quality and productivity of tea. Long-term research is recommended to confirm the findings.

Keywords: Altheon; *Camellia sinensis*; foliar fertilization; graphene oxide; total polyphenols



Paper ID: NSALS '26-176 (Oral)

Optimization of Enzymatic Deproteinization of Natural Rubber Latex for Enhanced Stability

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Enzymatic deproteinization is a potential solution to reduce protein content in Natural Rubber Latex (NRL), but its impact on latex stability has not been critically evaluated. Therefore, this study was undertaken to prepare and characterize NRL treated with the Savinase enzyme with the intention of synthesizing Deproteinized Natural Rubber Latex (DPNRL) while maintaining its stability. NRL samples were treated with different concentrations of Savinase enzyme (0, 0.5, 1.0, 1.5, and 2.0 phr) and 1.0 phr of non-ionic surfactant. The control sample and treated samples were centrifuged at Lalan Rubber (Pvt.) Ltd., Bulathsinhala. The variation in latex properties, such as Volatile Fatty Acid (VFA) content and Mechanical Stability Time (MST), was evaluated over a four-week storage period at one-week intervals, in accordance with ISO standards. The control sample recorded the highest VFA and MST. The MST of the enzyme-treated samples decreases as the enzyme concentration increases, while maintaining the colloidal stability throughout the storage period. There was a significant interaction ($P < 0.05$) between enzyme concentration and storage time in the development of VFA and MST. Nitrogen (N) content, Extractable Protein Content (EPC), tensile strength, aging tensile strength, and tear strength were tested after preparing latex films in accordance with surgical glove formulation, after a one month of storage period. The latex film samples prepared under controlled conditions recorded the highest N content, EPC, tensile strength, aging tensile strength, and tear strength. The samples treated with the enzyme, along with surfactant, showed a progressive decrease in N content and EPC. All the treated latex samples showed EPC values below the industry norm of ≤ 500 $\mu\text{g/g}$. The tensile strength, aging tensile strength, and tear strength values of the 1.5 phr enzyme-treated sample were observed to be comparable to those of the untreated sample, indicating that a moderate enzyme concentration is suitable for maintaining desirable mechanical properties. It can be concluded that deproteinization treatment using Savinase concentration with 1.5 phr, and combined with 1.0 phr of non-ionic surfactant, effectively reduced allergenic proteins in NRL while maintaining its stability, chemical properties, and physico-mechanical properties.

Keywords: DNRL; enzymatic deproteinization; non-ionic surfactant; Savinase enzyme



Paper ID: NSALS '26-186 (Oral)

Development of “Smart Paddy”-A Web-based Fertilizer Scheduler for Paddy Farmers in Sri Lanka

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Paddy cultivation plays a vital role in ensuring food security in Sri Lanka; however, inappropriate fertilizer application remains a major challenge affecting productivity and environmental sustainability. Many small-scale farmers rely on traditional practices or manual calculations, which often lead to incorrect fertilizer timing and dosage. This study presents the development of “Smart Paddy,” a web-based fertilizer scheduling tool designed to support Sri Lankan paddy farmers in making informed fertilizer management decisions. The system was developed using R Shiny to generate fertilizer schedules based on crop growth stages and nationally recommended fertilizer guidelines. The tool provides clear and user-friendly outputs, enabling farmers to identify appropriate fertilizer types, application timings, and quantities. Initial evaluation indicated that the system improved the accuracy and consistency of fertilizer scheduling when compared to conventional manual methods and significantly reduced the time required for planning fertilizer applications. The proposed tool also simplifies decision-making and enhances accessibility to scientifically recommended fertilizer practices. Overall, smart paddy demonstrates strong potential as a digital decision-support system for sustainable paddy cultivation. It is recommended that such web-based tools be integrated into agricultural extension programs to improve fertilizer management efficiency and promote environmentally responsible farming practices in Sri Lanka. Future developments may include the integration of soil test data and mobile-based access to further enhance usability and impact.

Keywords: Decision support system; fertilizer scheduling; paddy cultivation; smart agriculture; web-based application



Paper ID: NSALS '26-209 (Oral)

Effect of Reusing Old (Waste) Natural Latex Compound on the Physio-mechanical Properties of Natural Rubber Gloves; Determination of Optimum Blend Ratios under Varying Swelling Indices

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The Natural Rubber (NR) glove industry generates significant waste in the form of Old Latex Compounds (OLC), which are discarded once their maturity exceeds acceptable limits for glove production. The increasing crosslink density of OLC, measured using the Toluene Swelling Index (TSI), reduces their suitability for further use. Disposal of these compounds not only contributes to environmental pollution but also increases production costs. This study aimed to determine the optimal OLC: Fresh Latex Compound (FLC) blend ratios at different TSI levels that can be reused in glove manufacturing without compromising key physio-mechanical properties, especially tensile strength and tear strength. OLC with TSI levels of 70% and 80% were blended with FLC in different ratios (5–45% OLC), and household gloves were produced. The physio-mechanical properties of the gloves were evaluated using a standard method (EN 455-2). Statistical analyses, including general linear model, Dunnett comparison, and regression analysis, were used to assess the effect of OLC percentage and TSI on glove properties. The results revealed that tensile strength and tear strength decreased significantly ($P < 0.05$) with increasing OLC content. Regression analysis showed a reduction of 0.1455 N/mm² in tensile strength and 0.1815 N in tear strength per 1% increment of OLC. However, certain blend ratios satisfied ISO standards (tensile strength > 15 N/mm²; tear strength > 10 N). At a 70% TSI level, the optimum ratio was 15% OLC:85% FLC, while at an 80% TSI level, the optimum was 35% OLC: 65% FLC. No significant interaction was observed between TSI level and optimum blend ratio ($P > 0.05$). Cost analysis indicated raw material cost saving of Rs. 93.42/kg of a compound at 15% OLC (70% TSI) and Rs. 217.98/kg at 35% OLC (80% TSI). Beyond cost reduction, reusing OLC contributes to sustainable glove manufacturing by reducing waste disposal and environmental pollution. The study demonstrates that controlled incorporation of OLC into glove formulations is a viable strategy for balancing product quality, economic efficiency, and environmental sustainability.

Keywords: Fresh latex compound; natural rubber latex; old latex compound; tear strength; tensile strength; toluene swelling index



Paper ID: NSALS '26-008 (Poster)

A Feasibility Assessment for ISO 9001:2015 Implementation Based on Gap Analysis in a Commercial Brush and Brush Block Processing Plant

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ISO 9001:2015 is the globally recognized foundation for Quality Management Systems, yet many Sri Lankan SMEs struggle to adopt it because of limited resources and underdeveloped systems. Using gap analysis as a staged pathway to compliance, this study assessed the ISO 9001:2015 implementation level in a Sri Lankan SME, identified clause-specific gaps, and prioritized them through a risk-based approach aligned with the standard. Based on verified gaps, clause priorities were assigned to develop a tailored feasibility plan for stepwise ISO 9001:2015 implementation. A structured questionnaire covering all 58 ISO subclauses was developed; 52 were retained for analysis because six were out of scope for the factory. Interviews with key department heads were conducted and validated through on-site observations and document review. This supports realistic planning for resource-limited organizations. Selected clauses were given scores based on their implementation level. A combined framework of audit focus and impact on product quality was utilized to prioritize the gaps, where audit focus reflected likelihood, and product quality impact reflected severity. The final feasibility plan was prepared based on the requirements of the ISO manual and included solutions such as short-term, mid-term, and long-term, based on complexity, requirements of resources, and strategic importance. According to the analysis, out of 52 considered clauses, 26 (50%) were critical/not implemented clauses, 6 (12%) were moderate/partially implemented, and 20 (38%) were implemented. Among critical clauses, 10 were identified as high-priority clauses, 14 were medium-priority, and 2 were low-priority clauses. Among moderate clauses, 2 were high-priority, and 4 were medium-priority clauses. According to prioritization, clauses were integrated into a final feasibility plan that contained short-term, mid-term, and long-term solutions for systematic implementation of the standard. Therefore, this study provides a practical and scientific model for gap analysis, gap prioritization, and feasibility plan preparation for implementing the ISO 9001:2015 standard in SMEs.

Keywords: Clauses; feasibility plan; gap analysis; implementation; ISO 9001:2015



Paper ID: NSALS '26-054 (Poster)

Determination of the Effect of Green Synthesized Carbon Nanomaterial on Physico-mechanical Properties of Natural Rubber Latex

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The growing demand for sustainable nanomaterial synthesis has intensified research into eco-friendly approaches that minimize hazardous waste generation. This study presents a novel green synthesis method for producing carbon-based nanomaterials from coconut shell waste using unripe papaya (*Carica papaya*) latex as a natural bio-activator and aluminium oxide (Al₂O₃) as an auxiliary precursor and evaluates their effects on the physico-mechanical properties of Natural Rubber Latex (NRL) composites. The porous carbon was generated from Coconut Shell Charcoal Powder (CSCP) in the presence of papaya latex (CSCP+P) and papaya latex along with Al₂O₃ (CSCP+P+Al) at a temperature of 60°C for 4 h. The high-energy ball milling process up to 600 rpm, 2 h was applied to the porous carbon material types (CSCP, CSCP+P, CSCP+P+Al). SEM analysis showed predominantly quasi-spherical and irregular carbonaceous particles resembling carbon dot-like morphologies, with only limited and isolated fibre-like features. X-ray diffraction analysis revealed predominantly amorphous carbon structures for CSCP and CSCP+P samples, while relatively sharper diffraction features observed for CSCP+P+Al were attributed mainly to the presence of Al₂O₃ rather than crystallized carbon. Fourier transform infrared spectra showed noticeable changes at 1017 c/m and 2112 c/m, suggesting surface chemical modification of the carbon material after treatment. The synthesized carbon materials were incorporated into a low-ammonia centrifuge NRL matrix along with other crosslinking components at weights of 2.5%, 5%, and 7.5% using a pre-vulcanized latex compounding process. Physico-mechanical testing showed that tensile strength (13–18 N/m²) and elongation at break (600–1000%) showed no significant improvement with increasing nanomaterial weight. However, a significant reduction in swelling index (258–163%) was observed, particularly for CSCP+P+Al composites, indicating increased crosslinking density and filler-matrix interactions. This research demonstrates the effectiveness of papaya latex as a sustainable bio-activating agent for producing nanostructured carbon materials from coconut shell waste with fibre-like features, while generating functional nanomaterials suitable for polymer reinforcement applications. The findings contribute to the advancement of environmentally conscious nanomaterial production methods and suggest potential for scaling up sustainable carbon nanomaterials synthesis for industrial applications.

Keywords: Carbon-based nanomaterials; coconut shell waste; green synthesis; natural rubber nanocomposites; papaya latex



Paper ID: NSALS '26-060 (Poster)

Land Suitability Assessment for Tea Cultivation using Machine Learning Approach in Uva Province, Sri Lanka

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Tea is a vital crop in Sri Lanka, with the Uva province playing a key role in producing tea with unique flavor characteristics. Environmental factors, such as climate, soil, and topography, significantly influence tea cultivation. However, climate change is a growing challenge that may affect the future land suitability for tea. Random Forest (RF) algorithm is used instead of Multi-Criteria Decision (MCD) to identify complex and non-linear interactions between environmental factors. Therefore, this study was carried out to predict the suitability of tea land for the years 2040, 2060, and 2080 in Uva Province using the RF algorithm. Climatic data, soil data, and topographic data were collected from WorldClim, Mendeley Data Repository, and ASTER DEM, respectively. For a regional-scale land suitability study, a 1 km² spatial resolution was chosen to preserve consistency across climate, soil, and topography variables. Existing tea lands (270.06 km²) were digitized using Google Earth Pro. Environmental factors and mapping tea land data were used to train the Random Forest (RF) model. In the data set, 30% were used for validation and the other 70% for training. The RF model was built using 100 trees with an accuracy of 87.2%. Based on the RF classification result, slope and elevation showed the highest influence values of 40.63% and 38.62%, followed by 3.32%, 3.32%, 3.24%, 3.13% and 3.13 for bulk density, cation exchange capacity, organic carbon, pH, and drainage, precipitation (1.60%), maximum temperature (1.22%), and minimum temperature (1.30%) had the lowest contribution to the model. Moreover, tea land suitability was predicted under four climate scenarios (SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5) using the WorldClim data. The findings emphasized that suitable tea land remains relatively stable between all scenarios but significantly increases compared to the current land extent, which was only 12% of the study area. The highest suitable land area of 2,243 km² and 2,256 km² was observed under SSP2-4.5 in 2060 and SSP5-8.5 in 2080. The lowest values were observed in years 2060 (2,209 km²) and 2040 (2,212 km²) in SSP 3-7.0 and 1-2.6. Therefore, the study shows that topography and soil play a stronger role than climate in determining tea land suitability in elevated areas in Uva province.

Keywords: Climate change; land suitability; machine learning; random forest; tea



Paper ID: NSALS '26-065 (Poster)

A Biodegradable Handmade Craft Sheet using Waste Coconut Milk Residues with Coconut Coir Fiber

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This study focused on the development of a biodegradable handmade craft sheet using waste coconut milk residues (coconut dregs), coconut coir fiber, and natural binders. The primary objective was to utilize locally available agricultural by-products to produce an eco-friendly alternative to conventional paper material, thereby reducing waste-related environmental impacts and dependency on wood-based resources. Sixteen independent formulations were prepared by systemically varying raw material ratios, co-fiber inclusion, binder type (potato starch, okra extraction, and cashew gum), alkaline pretreatment, and drying surface conditions (sticky muslin cloth and non-sticky polythene sheet). The initial trials demonstrated that coconut dregs alone were insufficient for sheet formation due to short fiber length and weak inter-particle bonding. Incorporation of coconut coir fiber as a co-fiber improved the structural integrity, while alkaline pretreatment using dilute sodium hydroxide (4% NaOH for coconut coir fiber and 3% NaOH for coconut dregs) enhanced fiber flexibility and bonding. Among the binders evaluated, cashew gum showed superior adhesion compared to potato starch and okra extract. Coconut coir fiber size reduction (approximately 3–4 mm) further influenced sheet cohesion and flexibility. The optimized formulation exhibited improved foldability, reduced tearing, lower swelling behavior in water, and faster biodegradation in soil compared to other samples, indicating characteristics close to an ideal craft sheet. Basic physico-mechanical evaluations, including paper thickness, weight, swelling behavior (water and moisture absorption), folding ability, and biodegradability through soil burial test over a short period, were performed to support the selection of the best formulation. Although limitations such as surface roughness and non-uniform thickness were observed, the study confirms the feasibility of producing biodegradable craft sheet from coconut-based waste materials. This work represents an initial step toward sustainable crafts (painting and drawing sheets, lighter-weight application bags, nursery planting trays, and seed germination trays) and packaging material development, with further optimization required to improve uniformity, strength, and application performance.

Keywords: Agricultural residues; biodegradable craft sheet; coconut milk residues; coir fiber; delignification; waste management



Paper ID: NSALS '26-079 (Poster)

Effect of Origin and Processing Methods on Antioxidant Properties of Green Tea

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Green tea (*Camellia sinensis*) is one of the most widely consumed beverages in the world, and its health properties, particularly its antioxidant activity, have been documented in scientific literature. These antioxidants, which play a crucial role in our health, inhibit the oxidation of other molecules, such as free radicals, which can damage cells. Green tea's high antioxidant content comes from polyphenols, such as catechins, which exhibit antioxidant activity and help reduce oxidative stress, thereby improving overall health. Additionally, green tea processing steps, including drying, pan-firing, and steaming, have an impact on the stability and absorption of oxidizing chemicals. These antioxidants are responsible for scavenging free radicals and thereby relieving oxidative stress and reducing the risk of chronic illness. The main objective of this study was to evaluate the effect of origin (India, China, Japan and Indonesia) and processing methods, such as fixing method and drying method, on the antioxidant properties of green tea. This study utilized systematic meta-analysis to analyse 1,639 studies from five databases, screening 44 studies with 930 data points, using the preferred reporting items for systematic reviews and meta-analyses methods. Antioxidant capacity was assessed by different assays such as DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid), ORAC (Oxygen radical absorbance capacity), and FRAP (ferric reducing antioxidant power). Green tea's antioxidant content is particularly noteworthy, highlighting its potential health benefits. The overall antioxidant assay from cluster analysis revealed that antioxidant activity produced in India and China was higher than in other countries. Oven dryer and hot air dryer can be grouped because they have similar antioxidant activity and were better than green tea dried under the microwave oven method. No significant differences were observed between the fixing methods, such as steaming and pan firing, indicating that the processing method may not have a substantial impact on antioxidant activity.

Keywords: Antioxidant activity; green tea; meta-analysis; origin; polyphenols; processing methods



Paper ID: NSALS '26-100 (Poster)

Evaluation of the Physico-mechanical Properties and Curing Characteristics of Rubber Composites Filled with Boron-coated Expandable Graphite Nanofiller

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The properties of rubber compounds are highly influenced by the type and loading of reinforcing fillers. Conventional fillers such as Carbon Black (CB) improve properties of rubber compounds but often require high loadings, which increase production costs. This study investigates the potential of Boron-coated Expandable Graphite (BEG) as a novel nanofiller to enhance the physico-mechanical, curing characteristics, swelling, and water absorption of Natural Rubber (NR) and Butadiene Rubber (BR) blend (70/30 phr). BEG was synthesized by surface modification of EG with polyvinyl alcohol (PVA) and 5% boric acid to improve compatibility and suppress the “popcorn effect”. EG was prepared using fine flake graphite as raw material, 98% H₂SO₄ as an inserting agent, and KMnO₄ as oxidant at the ratio of 1:5:0.75, respectively. The ball milling method was used to reduce the particle size. The synthesized EG and BEG were characterized using Fourier transform infrared spectroscopy and X-ray diffraction. Rubber compounds were prepared with varying BEG concentration (1, 1.5, 2 and 2.5 phr) as substitutes for CB, and their properties were compared with a control compound filled with 60 phr carbon black. Cure characteristics, physico-mechanical properties, swelling index, and water absorption of the different rubber compounds were evaluated. At 1.5 phr concentration, BEG maintained tensile strength close to the control with a 2.35% reduction ($P < 0.05$), significantly improved elongation at break by 379% ($P < 0.05$), reduced hardness by 46.43% ($P < 0.05$), and increased resilience by 40.68% ($P < 0.05$), while compression set increased by 63.68% ($P < 0.05$) and cure rate index increased by 1.43% ($P < 0.05$) compared to the control. The study indicates that BEG, even at low loadings, introduces distinct property enhancement compared to conventional fillers. The findings highlight the potential of BEG as a cost-effective and multifunctional nanofiller for advanced rubber applications, such as tire tubes. This work contributes to sustainable material development by reducing filler usage while achieving improved mechanical and curing properties.

Keywords: Boron-coated expandable graphite; cure characteristics; mechanical properties; nanofiller; rubber blend



Paper ID: NSALS '26-106 (Poster)

Development of Shoe Sole Material from Reclaimed Rubber and Recycled Plastics with Natural Rubber

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The rubber and plastics industry is facing a major challenge this decade in managing waste rubber goods and plastics, which pose environmental hazards. The development of composite materials using reclaimed rubber and waste plastics could be a solution to overcome these challenges. Therefore, this study aimed to formulate a composite material for shoe soles from reclaimed rubber and recycled plastic. Different formulations were prepared by varying the Reclaimed Rubber (RR) to Polypropylene (PP) fibers [RR:PP = 100:0 (S1 - control), 80:20 (S2), 60:30 (S3), 40:60 (S4), and 20:80 (S5)] ratios while maintaining a fixed Ribbed Smoked Rubber (RSS) content of 50 phr. Fine grade Reclaimed rubber, average waste PP fibers, and RSS were mixed using a laboratory-scale two-roll mill. The particle size of the PP was 10 mm in length. The vulcanization process is carried out at a temperature of 115–125°C for 16–20 minutes under a compression molding pressure. The functional groups in the chemical blend were examined by Fourier transform infrared spectroscopy, and physico-mechanical properties such as tensile strength, tear strength, hardness, abrasion resistance, and flexibility were tested according to the ISO standards. Among the examined samples, S3 showed a hardness of 79.47 International Rubber Hardness Degree, abrasion loss of 160.39 mm³, tensile strength of 4.75 MPa, Tear strength of 31.67 N/mm, and flexibility recovery rate of 72.72%, which demonstrates the optimum performance. Tear strength and tensile strength were significantly ($P < 0.05$) lower than those of the control when adding PP. The findings showed that PP-rich mixes improved hardness, whereas RR-rich formulations had greater tensile strength, tear resistance, and flexibility than the control. This study highlights the potential of recycled PP and reclaimed rubber as raw materials to produce shoe soles, inducing both economic viability and environmental advantages.

Keywords: Polypropylene; reclaimed rubber; recycled PP fibres; shoe sole; thermoset



Paper ID: NSALS '26-111 (Poster)

Deep Learning Approach for Maturity Classification of Guava Fruits (*Psidium guajava*)

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This research presents the design and evaluation of an automatic guava fruit maturity classification system using advanced deep learning YOLO (You Only Look Once) models, YOLOv8, and YOLO11. The first data set used in this study consisted of high-resolution guava fruit images captured under controlled laboratory conditions with a plain white background. The dataset included images representing three distinct maturity stages: immature, half-mature, and mature, captured under uniform lighting and fixed camera angles to minimize background noise and color distortion. Image preprocessing techniques, including resizing to 640×640 pixels and normalization, were applied to ensure consistency before training. Both YOLOv8 and YOLO11 models were trained and fine-tuned with optimized hyperparameters, including learning rate, batch size, and number of epochs, to achieve maximum accuracy. Data augmentation techniques like rotation, flipping, and brightness adjustment were implemented to enhance dataset diversity and improve model robustness. Under these controlled conditions, both models achieved high accuracy, with near-perfect values of precision, recall, and F1-score across all maturity categories. The high contrast between the guava fruit and the white background allowed the models to clearly identify edge features, texture variations, and color differences among maturity stages. The results demonstrated that YOLOv8 and YOLO11 models, particularly the larger variants (YOLOv8x and YOLO11x), exhibited outstanding generalization performance even on unseen test data. These findings confirm that deep learning-based object detection techniques can achieve reliable, consistent, and highly accurate fruit maturity classification in controlled environments, laying a strong foundation for automated grading systems in precision agriculture.

Keywords: Deep learning; guava fruit; image datasets; maturity classification; model evaluation; YOLO



Paper ID: NSALS '26-148 (Poster)

Design and Fabrication of Prototype Pulp Extractor for Palmyra Fruit

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The Palmyra fruit (*Borassus flabellifer*) is a nutritionally valuable tropical crop that contributes significantly to rural and local economies. However, pulp extraction is still largely performed using manual methods, which are labor-intensive, time-consuming, and result in low and inconsistent yield efficiency. Despite its economic importance, a mechanical pulp extractor specifically designed for the fibrous nature of the palmyra fruit is scarcely reported in the literature. This study focuses on the design, fabrication, and experimental evaluation of a palmyra fruit with a specific pulp extraction prototype to improve extraction efficiency and reduce processing time. The developed machine comprises a motor-driven rotating disk with a blade, housed within a food-grade stainless steel (SS 304) extraction chamber, and supported by a manual pressing unit fitted with pyramid-shaped cones to assist pulp release. The system is powered by a 0.5 hp single-phase electric motor operating at controlled rotational speeds. Performance testing was conducted under laboratory conditions using replicated trials (5 samples for each) at two rotational speeds (4 rpm and 5 rpm), with results compared against conventional manual extraction methods. Key performance indicators included yield efficiency and extraction time. The experimental data were statistically analyzed using One-way ANOVA to assess the effect of rotational speed. Results indicated a statistically significant improvement in yield efficiency with increasing rotational speed ($P < 0.05$). The highest yield efficiency of 60% was achieved at 5 rpm, representing an improvement of approximately 30% compared to manual extraction, along with a noticeable reduction in extraction time. The findings demonstrate that the proposed palmyra-specific mechanical configuration effectively enhances pulp extraction performance under controlled laboratory conditions. While the prototype shows promising results, further research is required to optimize design parameters, quantify waste reduction, evaluate economic feasibility, and validate field-level applicability for small-scale and rural processing environments.

Keywords: Extraction time; palmyra fruit; pulp extraction; rotational speed; yield efficiency



Paper ID: NSALS '26-178 (Poster)

Investigating the Relationship between the Physicochemical and Sensory Properties of Selected Low-grown Tea Grades from Sri Lanka

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Tea (*Camellia sinensis* L.) is among the world's most consumed beverages, and its quality reflects linked chemical, physical, and sensory attributes. In Sri Lanka's low-grown zone (0-600 m), however, scientific evidence linking measurable quality parameters to sensory grading remains scarce. This study examined relationships between physicochemical characteristics and sensory profiles of low-grown black tea grades (OP1, FF1, PF1) produced by Orthodox and CTC manufacture. Samples were obtained from 12 factories using stratified random sampling based on Net Sales Average (NSA). Factories were classified by manufacturing type, then assigned to three performance strata as above, par, and below using the low-grown to-date average NSA from 27 May 2025 (Sale No. 20, Colombo Tea Auction) as the benchmark. Stratification was independent of region, with both Ruhuna and Sabaragamuwa represented in each stratum. Two factories per type were randomly selected from each NSA stratum. Accordingly, OP1 and FF1 samples were obtained from the same six Orthodox factories, while PF1 samples were collected from six CTC factories, resulting in six samples per grade (n=6). Physicochemical properties, including liquor color (L, a, b), haze value (NTU at 30°C and 40°C), pH, moisture content (%), water extract (%), and total polyphenol content (TPC, %) were analyzed. Sensory evaluation was performed by six expert tasters following ISO 3103 standard procedures. Data were analyzed using descriptive statistics, Kruskal-Wallis tests for differences across NSA categories, and Spearman's rank correlation to assess relationships between physicochemical properties and total quality score. Comparison across NSA categories showed that most physicochemical parameters and total quality scores did not differ significantly among above, par, and below categories for any grade ($P>0.05$), indicating substantial variability among factories within the same NSA category. Despite this, grade-specific associations were observed. In OP1, liquor redness (a^*) exhibited a strong positive correlation with sensory score ($\rho=0.943$, $P=0.005$). In FF1, moisture content showed a strong negative correlation ($\rho= -0.841$, $P=0.036$), while water extract showed a strong positive correlation with sensory score ($\rho=0.841$, $P=0.036$). In PF1, pH exhibited a strong negative correlation ($\rho= -0.841$, $P=0.036$), and moisture content showed a strong positive correlation ($\rho=0.841$). Other physicochemical parameters showed weak or non-significant associations. Certain properties may relate to sensory quality within specific grades, but NSA-based categorization did not reliably differentiate factory quality. Due to limited samples, larger datasets and validated predictive models are needed.

Keywords: Low-grown black tea; NSA; physicochemical properties; sensory evaluation



Paper ID: NSALS '26-203 (Poster)

Assessment of Isotope Variation in the Soil Plant Atmosphere System of Hybrid Chili (*Capsicum annuum*) Variety MICH HY1 Grown in a Protected House

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Isotope-based evapotranspiration partitioning is crucial for establishing sustainable irrigation management practices to maximize the usage of available, accessible fresh water. In Sri Lanka, conventional evapotranspiration measuring methods cannot separate evaporation and transpiration. This study aimed to assess the isotope variation in the soil-plant-atmosphere system of green chili (*Capsicum annuum*) grown in protected house conditions and to examine the agronomic performance under mulching. This research was conducted using the MICH HY1 chili hybrid variety at the National Centre for Non-Destructive Testing, Sri Lanka Atomic Energy Board, Kelaniya. There were three treatments: T1 - with plants and the soil surface was covered using black polythene, T2 - with plants and the soil surface was not covered, T3 - without plants (bare soil). Growth parameters, including the number of leaves, flowers, pods, plant height, and the pod dry weight, were measured. Atmospheric water vapour was collected using a cryogenic trap for stable water isotope analysis. Cryogenic vacuum distillation was done to extract water from soil samples and leaf samples. Parametric and non-parametric analyses were done using Minitab v.17 software. Mulching significantly increased the number of leaves, flowers, pods, and pod dry weight compared to non-mulched conditions ($P < 0.05$), while plant height did not differ significantly among treatments ($P > 0.05$). Considering the growth parameters, the mulched condition resulted in the best performance. Stable water isotopes of water extracted from soil and atmospheric moisture separated into two clusters, and the isotopic composition of irrigation water is close to the local meteoric water line. Due to isotopic fractionation, lighter isotopes (^1H , ^{16}O) left soil first, entered the atmosphere, and heavy water isotopes remained in soil water. Due to that, soil water shows more positive values as lighter isotopes leave the soil surface. When considering the atmospheric moisture, it shows more negative values due to the presence of lighter water stable isotopes. These findings demonstrated that stable isotope techniques reliably partition evapotranspiration and provide a basis for promoting mulching as a sustainable irrigation management practice.

Keywords: Agronomic performance; cryogenic vacuum distillation; evapotranspiration partitioning; green chili; stable water isotopes



Paper ID: NSALS '26-207 (Poster)

A Novel Approach to Synthesise Chlorinated Natural Rubber: Direct Chlorination of Centrifuged Latex

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Natural Rubber (NR), is a versatile material with excellent elasticity and energy-absorbing properties, making it indispensable across diverse industrial applications. NR can be chemically modified to enhance its performance and market value to make value-added grades with unique properties. One such derivative rubber is Chlorinated Natural Rubber (CNR), which exhibits good bonding power and resistance to chemicals, heat, and water compared to NR. The chlorination process modifies the isoprene units through addition reactions at the double bonds, simultaneously generating hydrochloric (HCl) acid as a by-product. One method of commercially synthesizing CNR is by chlorinating NR dissolved in carbon tetrachloride (CCl₄) with gaseous chlorine, a method that is not only costly but also time-consuming. To overcome these limitations, the present research aims to study the feasibility of direct chlorination of centrifuged latex using chlorine gas under exposure to UV light, as an effective alternative approach to CNR production. Two sets of chlorinated NR samples were synthesized in a laboratory-scale setup by varying the reaction time at two different UV light intensities at 250 nm and 365 nm. According to the results, the lowest chlorine content, 48.67%, was observed under 365 nm intensity after 3 hours, while the highest chlorine content, 55.44%, was recorded under 250 nm intensity after 4 hours. The chlorine content analysis yielded a *P*-value of 0.001. This indicates that both the intensity of UV light and the reaction time have a statistically significant effect on the chlorine content of the chlorinated rubber. The data reveal a positive correlation between chlorine content and both the intensity of UV light and reaction time. Since the intensity of UV light is directly proportional to the energy it imparts, UV light at 250 nm provides higher energy than at 365 nm. Chlorine gas absorbs UV radiation, causing the dissociation of Cl-Cl bonds into reactive chlorine free radicals. UV light at 250 nm generates more free radicals, resulting in higher chlorine content in chlorinated rubber. The duration of a reaction significantly influences chlorine incorporation.

Keywords: Chlorinated natural rubber, direct chlorination, modified grade rubber, UV light



Paper ID: NSALS '26-208 (Poster)

Exploring the Potential of Dipterocarp Resin in Scented Candle Development

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The growing demand for renewable and traceable aromatic materials has increased interest in plant resins; however, endemic Sri Lankan dipterocarp resins remain poorly characterized for modern fragrance applications. This proof-of-concept study evaluates resins from *Shorea megistophylla* and *Shorea affinis*, which are dipterocarps and, alongside *Canarium zeylanicum*, as fragrance bases for scented candle formulations, aiming to establish baseline chemical fingerprints and preliminary sensory performance rather than introducing novel extraction methods. Resins were sustainably harvested from naturally exuding trees, cleaned, air-dried, and ground prior to Soxhlet extraction using methanol (150 mL, 65°C, 48 h), following validated protocols to ensure exhaustive compound recovery and analytical reproducibility. Although methanol is not a green solvent, its use was restricted to laboratory-scale screening, and solvent removal was performed under reduced pressure, providing an analytical benchmark. Extraction yields, expressed as mean±SD from three independent extractions per species, were highly reproducible and comparable (*S. megistophylla*: 57.41±0.20%; *S. affinis*: 57.34±0.10%; *C. zeylanicum*: 57.22±0.10%), with One-way ANOVA showing no significant inter-species differences ($P>0.05$). FTIR and GC-MS analyses revealed species-specific profiles dominated by terpenoid and resin-acid derivatives. *S. megistophylla* was characterized by a major GC-MS peak of (E, E)-farnesyl acetate (at retention time 13.19 min), while *S. affinis* exhibited a more complex profile including (E, E)-farnesyl acetate, (E, E)-farnesol (at retention time ~12.9 min), and n-hexadecanoic acid (at retention time ~17.5 min). Application relevance was evaluated using scented candle prototypes containing 5-20% (w/w) resin extracts, assessed by a blinded consumer panel (n=50) on a 9-point hedonic scale, revealing species-specific optimal acceptance levels. This study provides the first integrated chemical-sensory dataset for Sri Lankan dipterocarp resins in scented candle applications and offers a foundation for future research on greener extraction strategies and sustainable product development.

Keywords: Dipterocarp resins; GC-MS analysis; methanol Soxhlet extraction; scented candle product; sensory evaluation; Sri Lanka



AGRICULTURAL MICROBIOLOGY AND BIOTECHNOLOGY

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R.M.B.M. Rathnayake, N.W. Gunasekara, D.N. Wanasinghe, M.K. Meegahakumbura



Paper ID: NSALS '26-011 (Oral)

***In-silico* Screening of Phytochemicals from *Tamarindus indica* L. to Inhibit the Action of LSDV114 Hypothetical Protein of Lumpy Skin Disease in Cattle**

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Lumpy Skin Disease (LSD) is a one of the major diseases which is caused by the Lumpy Skin Disease Virus (LSDV), and it is leading to clinical symptoms that include nodular lesions on the skin and systemic illness characterized by high fever, arthritis, mastitis and resulting in significant economic losses for the livestock sector. There are some vaccines and treatments are available for LSD, but those vaccines may not provide cross-protective immunity for different strains of LSDV; thus, it makes the requirement of the identification of novel antiviral compounds to control LSD. This study targets the LSDV114 hypothetical protein and aims to inhibit the action of this protein by using the compounds that are derived from the *Tamarindus indica* L. (Tamarind). The targeted protein, LSDV114 hypothetical protein, was identified through the VexiJen server based on its high antigenic value (0.68), then its amino acid sequence was retrieved from the UniProt database, and the 3D structure was predicted using the AlphaFold3 server, while it was refined with Galaxy Refine server and finally validated with Ramachandran plot. Natural compounds from the *Tamarindus indica* L. were obtained from PubMed, SCOPUS, ResearchGate, ScienceDirect, Google and Google Scholar databases for studies published before 2025. Then selected compounds were evaluated for their absorption, distribution, metabolism and excretion properties using DataWarrior. Then according to Lipinski's rule of five non-toxic potentially safe natural compounds were selected and with those selected compounds virtual screening was done by using PyRx 8.0, from that Germinicol, β -Amyrone, α -Amyrin were selected according to their high binding affinity with greater than -6 kcal/mol. Moreover, those selected compounds were further docked with CB-Dock2 and results revealed α -Amyrin has the highest binding affinity of -7.9 kcal/mol. Overall, this study is important to identify the novel plant-derived phytochemical compounds targeting LSDV, with the potential to support proactive control efforts, protect cattle production, and mitigate economic losses in Sri Lanka's livestock industry.

Keywords: *In-silico*; LSDV114 hypothetical protein; lumpy skin disease; *Tamarindus indica* L.

Acknowledgement: Financial assistance from University Research Council, Multidisciplinary Research Grant (No. 516), University of Peradeniya, Peradeniya, Sri Lanka is acknowledged



Paper ID: NSALS '26-012 (Oral)

***In-silico* Exploration of Chaperonin GroEL Inhibitors from *Vitex negundo* L. Leaf Extract Against *Streptococcus agalactiae* to Control Bovine Mastitis**

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Mastitis is a prevalent and economically significant disease in dairy cows, leading to decreased milk production and quality. A major causative agent is *Streptococcus agalactiae*, a highly virulent bacteria that enters through the teat canal, often during milking or due to environmental contamination. Although antibiotics are often used, they can lead to antibiotic resistance and harmful residues in milk. Consequently, antibiotic-based treatment for mastitis is increasingly discouraged due to its risks to both animal and human health. This highlights the urgent need for alternative therapeutic strategies that are safe, effective, and sustainable. Chaperonin GroEL, considered a virulence factor, plays a key role in bacterial pathogenesis and in the folding of a broad range of proteins, particularly those that are large, slow-folding, and prone to aggregation. Targeting chaperonin GroEL therefore represents a promising approach to reduce bacterial survival and virulence. The present study aimed to identify bioactive compounds from *Vitex negundo* L. leaves that could inhibit chaperonin GroEL and thereby interfere with bacterial pathogenicity and protein folding. The UniProt database was used to retrieve the amino acid sequence of chaperonin GroEL and its 3D structure was predicted by using AlphaFold 3, refined with GalaxyRefine, and validated with the SAVES server. A total of 117 compounds from *Vitex negundo* L. were retrieved from PubChem for computational screening. Virtual screening using PyRx 8.0 identified 27 compounds with binding affinities stronger than -5 kcal/mol. These were further analyzed via blind docking with CB-Dock2, revealing significant interactions with the chaperonin GroEL active site. Additionally, absorption, distribution, metabolism and excretion properties were assessed, and Lipinski's rule of five applied to evaluate drug-likeness and safety. Among all compounds, Imazosulfuron and Aralionine A showed the strongest binding affinities of -9.6 kcal/mol and -9.9 kcal/mol, respectively. These results highlight them as promising chaperonin GroEL inhibitors, warranting further experimental validation as plant-derived therapeutic agents against bovine mastitis.

Keywords: Bovine mastitis; chaperonin GroEL; *Streptococcus agalactiae*; *Vitex negundo* L.

Acknowledgement: Financial assistance from University Research Council, Multidisciplinary Research Grant (No. 516), University of Peradeniya, Peradeniya, Sri Lanka is acknowledged



Paper ID: NSALS '26-032 (Oral)

Effects of Biofilm Biofertilizer on Tea Quality: A Spectroscopic Approach

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Long-term chemical fertilizer dependence on Sri Lanka's tea plantations has led to soil degradation and lower leaf quality. A field comparison was conducted between conventional Chemical Fertilizer (CF) practice and Bio Film Bio Fertilizer (BFBF) practice of 50% CF + 2.5 BFBF L/ha to evaluate a more sustainable alternative. The BFBF used in this study is a microbial biofilm community able to solubilize nutrients and fix N. Soil parameters (available N, P, K, pH, EC, moisture, and temperature) and tea leaf chlorophyll content were measured. Tea leaf extracts in 80% methanol with 0.1% acetic acid were examined for ATR-FTIR spectroscopy in semi-quantitative analysis. Dominant bond vibrations of functionally active groups (O–H, N–H, C–H, C=O, C–O) concerning bioactive compounds were considered. The study compared 100% CF against 50% CF + BFBF over a single season. Statistical tests were conducted at $\alpha=0.1$, with $P<0.1$ considered significant. Higher absorbance intensities at ~3380-3400, ~1640, and ~3300-3400 to 1550/cm band were observed under BFBF, indicating relatively stronger signals from phenolic, caffeine-related, and amino-associated vibrations. The bands O–H and N–H were significantly higher ($P<0.001$), whereas the 1640/cm band showed a slight increase. Chlorophyll and soil conditions (pH, EC, moisture, temperature) did not differ significantly ($P\geq 0.10$). ATR-FTIR revealed comparatively higher bioactive-related compounds in BFBF within semi-quantitative scales. Soil N, P, and K were slightly lower in BFBF ($P<0.10$), which might be attributed to microbial immobilization of soil NPK and subsequent slow release, as well as promotion of secondary metabolic pathways by mild NPK deficiencies. BFBF maintained tea bioactive quality despite reduced CF. ATR-FTIR offers a rapid, semi-quantitative comparison despite precisely quantifying compounds due to spectral overlap, and strong quantification requires validated analytical and chemometric methods in future studies.

Keywords: ATR-FTIR; biofilm biofertilizer; spectroscopy; tea cultivation; tea quality



Paper ID: NSALS '26-056 (Oral)

Effect of Kinetin on Shoot Multiplication of Pineapple (*Ananas comosus* var. MD2)

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The MD2 pineapple (*Ananas comosus* var. MD2) is a globally preferred cultivar due to its unique sweetness, low acidity, and high market demand. However, conventional propagation through suckers and slips is slow, season-dependent, and prone to pathogen transmission, limiting large-scale production. *In-vitro* micropropagation offers an efficient alternative, and the use of cytokinin is significant in *in-vitro* shoot proliferation. Kinetin (6-furfurylaminopurine) is considered a potential cytokinin for improving shoot multiplication while maintaining morphological normality. This study was conducted to evaluate the effect of different kinetin concentrations on the shoot multiplication of the pineapple variety MD2 under tissue culture conditions, combined with 6-benzylaminopurine (BAP), which was tested alone as a sole cytokinin and gave poor performance. Four treatments were tested using Murashige and Skoog medium supplemented with 0.5 mg/L BAP and kinetin, *viz.*, 0.0 mg/L (control), 0.5 mg/L, 1.0 mg/L, and 1.5 mg/L. Data were collected on shoot multiplication rate, shoot length, number of leaves, leaf length, rooting, and callus formation to determine the optimal kinetin concentration for enhanced *in-vitro* propagation of MD2. Results indicated that kinetin significantly influenced the shoot proliferation and growth characteristics of MD2 pineapples. Among the treatments, 1.0 mg/L kinetin combined with 0.5 mg/L BAP produced the highest shoot multiplication rate (8.90 ± 0.28 shoots/explant). These explants also exhibited greater shoot length, leaf development, and improved overall performance compared to the control and other treatments. The 1.5 mg/L kinetin treatment resulted in reduced shoot multiplication (5.20 ± 0.41), shorter shoots, and less uniform leaf growth, suggesting that higher cytokinin levels may inhibit optimal shoot development. However, 0.5 mg/L kinetin promoted moderate shoot proliferation (6.70 ± 0.32) with elongated shoots and leaves. Root initiation was most pronounced in explants treated with 1.0 mg/L kinetin, indicating an optimal balance of cytokinin for coordinated shoots and roots development. The control (0.0 mg/L kinetin) exhibited minimal shoot proliferation (3.10 ± 0.35), weak shoot proliferation, and poor leaf expansion, highlighting the essential role of kinetin in *in-vitro* shoot induction. These findings contribute to the development of a standardized and efficient micropropagation protocol for MD2 pineapple.

Keywords: *Ananas comosus* var. MD2; BAP; *in-vitro* micropropagation; kinetin; shoots proliferation



Paper ID: NSALS '26-084 (Oral)

Evaluating the Potential of an Improved Tea-leaf Extract Agar (TEA) Medium for Isolation of *Exobasidium vexans*

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Blister blight is the most important and destructive foliar disease of tea (*Camellia sinensis*) that is caused by an obligatory parasite *Exobasidium vexans*. Further investigation of this fungus under *in-vitro* conditions has been limited due to its obligatory nature. A recent study has proven that hot water extracted, fresh tea-leaf infusion incorporated home-made PDA medium (TEA medium) has a positive influence on the *in-vitro* growth of *E. vexans*. However, that medium was also contaminated with common fungal endophytes due to the rich supply of dextrose inbuilt. Therefore, this study has been conducted as an extension to the TEA medium by reducing the original dextrose concentration to reduce the growth of contaminants while facilitating the *in-vitro* growth of *E. vexans* on fresh tea leaf extracts. Disease-infected leaf samples for the pathogen isolation and blister blight susceptible healthy tea leaves for the media preparation were obtained from the cultivar TRI 2025, located at the tea estates around Passara, Badulla. Twenty-five TEA media were tested, reducing the original potato concentration with five levels of hot water extracted fresh tea infusions (tea:potato; 100:0, 75:25, 50:50, 25:75, 0:100), and five reducing dextrose levels (20 g, 15 g, 10 g, 5 g, 0 g), while ensuring all other parameters are constant. Surface-sterilized diseased leaf segments were inoculated into each improved TEA medium and incubated at room temperature (25°C) for 10 days under 12 h dark and light conditions. The expected colony morphology was observed only on the medium incorporated with 25 tea:75 potato with 20 g/L dextrose, and the measured colony diameter was 8.8 cm. Based on the light microscopic morphology study, the mycelia were identified to be *E. vexans*, and it was demonstrated that reducing dextrose below 20 g/L to a low level has not supported the *in-vitro* growth of *E. vexans* in TEA media. Therefore, further studies with alternative Carbon sources suggest improving the TEA media to evaluate variations in the growth patterns of *E. vexans* under *in-vitro* conditions.

Keywords: *Camellia sinensis*; blister blight; dextrose; *Exobasidium vexans*; TEA media



Paper ID: NSALS '26-086 (Oral)

Evaluation of *In-vitro* Synergistic Anti-Inflammatory Effects of Polyherbal Preparation; Dichloromethane Leaf Extract of *Ipomoea pes-caprae* (Binthaburu) and *Scaevola taccada* (Thakkada)

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Chronic inflammation is a major cause of the global disease burden. Due to toxicity, side effects and inefficiency of existing anti-inflammatory drug regimens, continuous search for alternative novel drugs is inevitable. Plant-derived therapeutics are of major importance in this regard. Polyherbal preparations are particularly important as they may produce enhanced effects through synergism. This study investigated the *in-vitro* synergistic anti-inflammatory effects of dichloromethane leaf extracts of *Ipomoea pes-caprae* and *Scaevola taccada*; plants grown alongside the shoreline of Sri Lanka. While the plants have been individually investigated, their synergistic anti-inflammatory action has not yet been scientifically investigated. Following sample collection and authentication from Bandaranaike Memorial Ayurveda Research Institute, sequential extraction was performed, where the dichloromethane extract was obtained from the residue following the initial extraction using methanol. Botanical preparations were made as, A (*I. pes-caprae*), B (*S. taccada*), with three combinations, as C (A:B; 1:1), D (A:B; 1:2), E (A:B; 2:1). Anti-inflammatory activity was measured by egg albumin denaturation assay in the range of concentrations 6×10^{-3} to 6×10^{-7} g/mL, using diclofenac sodium as the positive control. Qualitative phytochemical tests were carried out to detect the presence of phenolic, terpenoids, flavonoids, alkaloids, and tannin compounds. All tests were done in triplicate, and statistical analysis was done via R version 4.4.3 software. Preparation E at 10^{-2} , 10^{-3} , and 10^{-4} showed significant anti-inflammatory activity with percentages 28.5%, 39.3%, 32% respectively. Dilutions 10^{-3} , 10^{-4} of preparation E recorded significantly higher percentages compared to the positive control, where 10^{-3} showed significant activity compared to the two individual preparations ($P < 0.05$). Phytochemical analysis revealed the presence of flavonoids and terpenoids in the preparations. The current study for the first time reports experimental evidence for synergistic anti-inflammatory interaction between *I. pes-caprae* and *S. taccada*. These findings suggest that this polyherbal preparation may serve as a promising lead for developing natural anti-inflammatory therapies. Further *in-vivo* studies and mechanistic investigations are needed to identify the active compounds and pathways responsible for the observed synergistic effects.

Keywords: Anti-inflammatory activity; egg albumin denaturation assay; *Ipomoea pes-caprae*; phytochemical screening; polyherbal synergy; *Scaevola taccada*



Paper ID: NSALS '26-116 (Oral)

Morphological and Molecular Characterization of Exotic Coconut Accessions in the Field Gene Bank of the Coconut Research Institute, Sri Lanka

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Coconut (*Cocos nucifera* L.) is a vital plantation crop in Sri Lanka, but the narrow genetic base of local germplasm restricts breeding progress. This study characterized twelve exotic accessions at the mature fruit-bearing stage conserved at the field gene bank of the Coconut Research Institute to assess their diversity and potential for future genetic improvement. Morphological descriptors were recorded for 34 palms, and molecular variation was evaluated using Simple Sequence Repeat (SSR) markers. The descriptive statistics were obtained for morphological parameters using Minitab ver.19, and Principal Component Analysis (PCA) was used to identify the relationship among varieties. The molecular data were analyzed using Power-Marker 3.25. According to the results, the tall types have a higher number of leaflets, as well as greater leaflet length and width, resulting in a larger leaf area. This may enable them to capture more lights and produce more assimilates through photosynthesis. In addition, longer petioles provide an added advantage in acquiring more irradiance. Reproductive traits showed that tall types have longer peduncles and central axes than dwarf, making them ideal for toddy tapping. The first two components of PCA explained 54.9% of the total variation, and the tall and dwarf varieties formed separate clusters, although some Laccadive Ordinary Tall and Andaman Ordinary individuals were grouped with dwarf. Substantial genetic diversity was confirmed by molecular analysis. Gene diversity values ranged from 0.50 to 0.73 (mean 0.63), and the three SSR loci amplified 5-6 alleles per locus (mean 5.3). The combination of average heterozygosity of 0.50 and Polymorphic Information Content values between 0.46 and 0.69 (mean 0.59) indicates a high level of informativeness of the markers. These results demonstrate the vital role of exotic germplasm in enhancing breeding programs and broadening the genetic base of Sri Lankan coconut, thereby supporting long-term sustainability in the face of shifting production and climate change.

Keywords: Coconut, exotic accessions, genetic diversity, morphological characterization, SSR markers



Paper ID: NSALS '26-150 (Oral)

Callus Development Potential of *Gymnema sylvestre* (Masbadda) in Organ Culture using Coconut Water in Media

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Gymnema sylvestre (Masbadda) is a valuable medicinal plant and a vulnerable species in Sri Lanka. This plant is widely used for its antidiabetic and pharmacological action because it contains "Gymnemic acid". However, seed germination and vegetative growth are suppressed in its propagation through conventional methods. Therefore, the present study was conducted to establish an efficient *in-vitro* callus induction. This study was intended to assess the influence of coconut water on callus development, and to determine the most suitable 2,4-D (2,4-dichlorophenoxyacetic acid) concentration for initiation and callus proliferation. Leaf explants were sterilized using 70% ethanol for 30 sec, then 0.5% NaOCl for 7 min, and 50 mg/L stock solution of streptomycin sulphate for 15 min, cultured on MS medium with varied coconut water levels (2.5%, 5%, 7.5% and 10%) and 2,4-D (2.0-2.5 mg/L). Reactions for growth in fresh weight, dry weight, callus length, texture, and color variation were recorded after inoculation for five weeks (35 days) from inoculation. Data were analyzed for treatment effects using non-parametric tests by using the Kruskal-Wallis rank sum test and the Chi-square test. Throughout the five weeks, color reduction rate was highly significant, and callus fresh weight, dry weight, callus length, and callus texture; all parameters were highly significant ($P < 0.05$). Results revealed that 7.5% coconut water and 2.5 mg/L 2,4-D containing medium produced maximum callus induction frequency with yellowish-cream friable callus for leaf explant with high significance. A watery or compact callus was obtained with increased concentration of coconut water due to hormonal or osmotic imbalance. It can be emphasized that the synergistic combination of optimized sterilization, 2,4-D levels, and intermediate coconut water had significantly enhanced *G. sylvestre* callus proliferation. This finding provides a foundation for subsequent studies on organogenesis, metabolite yield, and mass propagation of the medicinal crop in Sri Lanka.

Keywords: Callus induction; coconut water; 2,4-D; friable callus; gymnemic acid; *Gymnema sylvestre*



Paper ID: NSALS '26-151 (Oral)

Investigation into Quinolone Resistance in *Escherichia coli* Isolated from Chicken at Poultry Slaughter Establishments

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Increasing antimicrobial resistance in poultry sector is a major public health threat, particularly Quinolone antibiotic usage in food producing animals contributes to high resistance levels in foodborne pathogens. This study was conducted to investigate Quinolone resistance in *Escherichia coli* isolated from poultry. Objectives of this study were to determine the frequency of Quinolone resistance and to determine the presence of *gyr A*, *par C* genes in the Quinolone resistant samples. *Escherichia coli* was isolated previously from broiler caecum was recovered on MacConkey agar and re-confirmed employing a series of biochemical tests including triple sugar iron test, urease test, citrate test, sulfide indole motility test and gram staining. The antimicrobial susceptibility of confirmed *E. coli* isolate was determined by disk diffusion technique and agar dilution technique according to the guidelines of the European committee on antimicrobial susceptibility testing and clinical laboratory standards institute. All 100 *E. coli* isolates were tested against Ciprofloxacin (CIP) (5 µg), and 33 isolates were tested against Nalidixic acid (NA) (30 µg) due to resource constraints. The CIP resistant isolates were selected based on their minimum inhibitory concentrations in agar dilution test and DNA was extracted by boiling method. Polymerase chain reaction was performed targeting the presence of *gyr A* and *par C* genes and the specific bands were visualized in agarose gel electrophoresis. The results revealed that 91% of *E. coli* isolates were resistant against NA and 87% resistance to CIP in the disk diffusion technique. 99% resistance was detected against CIP in the minimum inhibitory concentration test and majority of the concentration values are significantly ($P < 0.05$) higher: ranging from 4 µg/mL to 256 µg/mL indicating widespread resistance. Presence of *gyr A* and *par C* genes were recorded as 73% and 83% of the Ciprofloxacin-resistant isolates respectively. In conclusion, quinolone resistance in *Escherichia coli* isolates obtained from chickens is alarmingly high, mostly due to the presence of *gyr A* and *par C* genes in the Quinolone resistant samples indicating the risk of resistance transmission within the food chain.

Keywords: Antimicrobial resistance; *Escherichia coli*; minimum inhibitory concentration; poultry; quinolone resistance



Paper ID: NSALS '26-183 (Oral)

Resistance Behavior of Hybrid Clones of Cluster Onion (*Allium cepa*) against Anthracnose Disease Caused by *Colletotrichum gloeosporioides*

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Red onion (*Allium cepa* var. *cepa*) is an important cash crop cultivated in Sri Lanka. Onion Anthracnose caused by *Colletotrichum gloeosporioides* is a major disease affecting onion production in the Dry zone of Sri Lanka. When environmental conditions are conducive, it spreads rapidly and affects the entire field, especially after the rainy season. Management of this disease is challenging because the fungus can survive in crop residues and plant debris. Screening of fifth-generation hybrid clones of cluster onion (*Allium cepa* Aggregatum Group) for resistance behavior against Anthracnose disease is essential for farmers to reduce pesticide usage and yield losses. The development of advanced hybrid clones, such as fifth-generation hybrids, is a crucial step in stabilizing these traits and ensuring consistent performance under field conditions. This study aims to evaluate the resistance behavior of fifth-generation hybrid clones of red onion against Anthracnose disease caused by *Colletotrichum gloeosporioides*. Forty-four hybrid clones were selected, and they were used as treatments. Two experiments were conducted. Growth parameters were taken in experiment-1. Disease incidence and disease severity index were taken in experiment-2. Completely randomized design for pot experiment-2 and randomized complete block design for field experiment-1 were used to perform ANOVA, and Tukey mean separation was administered to identify the best treatment at $P < 0.05$ using SAS 9.1. According to the results, a resistant hybrid clone was identified as a cross of MICLO1 × MH4 (E19), while moderately resistant hybrid clones were crosses of TVM6 × MICLO4 (E32), Vethalam (E44), MH4 × TVM6 (E21), TVM6 × MICLO4 (E31), and TVM6 (E43). Bulb yield was also significantly reduced ($P < 0.05$) due to Anthracnose in the onion. Therefore, the hybrid clones E19, E32, E44, E21, E31, and E43 (TVM6) were selected as promising based on disease tolerance capacity. These lines could be used for crop improvement programs or promoted for future variety release.

Keywords: Advanced hybrid clones; *Colletotrichum gloeosporioides*; onion anthracnose; red onion; resistance



Paper ID: NSALS '26-192 (Oral)

Optimization of an *In-vitro* Regeneration Protocol for Japanese Cucumber (*Cucumis sativus* L.)

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Japanese cucumber (*Cucumis sativus* var. *japonicus*) is a commercially and culinarily valuable crop recognized for its long, thin-skinned, mildly sweet fruits. However, conventional propagation methods are constrained by labor-intensive hand pollination and hybrid seed production, necessitating the development of an efficient *in-vitro* regeneration protocol for the Sri Lankan genotype. This study aimed to optimize surface sterilization, callus induction, and root organogenesis to establish an effective *in-vitro* regeneration system for Japanese cucumber. Six surface sterilization treatments using sodium hypochlorite (NaOCl) at concentrations of 2.0, 3.5%, and 5.0% for exposure periods of 10 and 15 minutes were evaluated. Among them, treatment with 3.5% NaOCl for 15 minutes was the most effective, achieving a high survival rate of 89% with minimal tissue damage, whereas 5.0% NaOCl for 15 minutes resulted in the lowest survival rate (55%). Callus induction was assessed using cotyledonary leaf, node, and hypocotyl explants cultured on Murashige and Skoog medium supplemented with 2,4-dichlorophenoxyacetic acid (2,4-D) at 0.5, 1.0, and 1.5 mg/L. The highest callus induction was recorded at 1.0 mg/L 2,4-D, yielding 72.0% in cotyledonary leaf, 68.75% in node, and 73.75% in hypocotyl explants. Dry matter content of callus derived from cotyledonary leaf and node explants was not significantly influenced by varying 2,4-D concentrations, indicating lower sensitivity to hormonal variation. In contrast, hypocotyl-derived callus exhibited a highly significant response ($P < 0.0001$), with 0.5 and 1.0 mg/L 2,4-D promoting the formation of compact and physiologically stable callus. Root induction was performed using indole-3-butyric acid (IBA; 0.5, 1.0, and 1.5 mg/L) in combination with 0.5 mg/L kinetin (KIN). The combination of 1.0 mg/L IBA + 0.5 mg/L KIN produced maximum root proliferation (16.71 ± 0.88 roots per explant), while 1.5 mg/L IBA + 0.5 mg/L KIN was most effective for root elongation (3.40 ± 0.15 cm). Overall, this study establishes a reliable protocol for surface sterilization, callus induction, and root regeneration, providing a foundation for efficient *in-vitro* propagation of Japanese cucumber in the Sri Lankan genotype.

Keywords: Callus induction; cucumber; *Cucumis sativus* var. *japonicus*; explant; *in-vitro* techniques



Paper ID: NSALS '26-196 (Oral)

***In-vitro* Evaluation of Selected Chemical Fungicides against Anthracnose Disease Caused by *Colletotrichum* spp.**

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Anthracnose caused by *Colletotrichum* spp. is a fungal disease of *Coffea arabica* L. that causes leaf blight, twig dieback, berry rot, and major crop losses. Identifying effective fungicides to control this pathogen is crucial to protect coffee plantations and maintain good yields. Therefore, the objective of this research was to isolate the causative agent of Anthracnose disease in coffee and find a suitable fungicide to control the isolated pathogen. The pathogen was isolated and purified from diseased coffee leaf samples collected from the fields of the export agriculture research center, Matale. A *Colletotrichum* sp. was morphologically identified after sub-cultured on Potato Dextrose Agar medium (PDA), and observation under a light microscope. A pathogenicity test was performed following Koch's postulates on healthy coffee plants using spore suspensions prepared by the isolated fungus, and the pathogen was confirmed by re-isolation and observation under a microscope. An *in-vitro* fungicidal test was performed using five commercial fungicides, namely Carbendazim 50% WP, Mancozeb 75% WG, Thiophanate-methyl 70% WP, Chlorothalonil 500 g/L SC, and 1% Bordeaux mixture as a control. The disc diffusion assay was performed in triplicate by placing each fungicide-impregnated disc on PDA plates containing the target pathogen, and the percentage inhibition of fungal growth was measured. The data were analysed using SAS. Carbendazim 50% WP, thiophanate-methyl 70% WP, and chlorothalonil 500 g/L SC showed significantly lower colony diameters ($P < 0.05$), and the percentage inhibitions were 71.53%, 60.16%, and 58.58%, respectively. Mancozeb 75% WG had the highest colony diameter (44.08 mm) and the lowest percentage inhibition (27.93%), indicating its lowest effectiveness. Overall, these results indicate that the fungicides Carbendazim 50% WP, Thiophanate-methyl 70% WP, and Chlorothalonil 500 g/L SC showed no significant difference ($P > 0.05$) in percentage compared to the control, which is the current chemical recommendation to control Anthracnose, indicating that the tested fungicides are effective alternatives for managing Anthracnose in Coffee in Sri Lanka.

Keywords: Anthracnose; *Coffea arabica* L.; *Colletotrichum* spp; disc diffusion assay



Paper ID: NSALS '26-199 (Oral)

Isolation and Molecular Identification of Plastic Biodegradation Bacteria from Badulla Dumpsite, Sri Lanka

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Plastic pollution has become a serious environmental problem globally. Among the various types of plastics, polyethylene terephthalate (PET) is highly resistant to natural degradation due to its stable chemical structure, and it contributes a major part of plastic waste. Traditional waste management practices such as landfilling, open dumping, and incineration have major drawbacks, whereas microbial biodegradation offers a more eco-friendly, cost-effective, and sustainable solution for PET disposal. This study focused on the isolation and molecular identification of plastic biodegrading bacterial strains from the Badulla municipal dumpsite in Sri Lanka. A plastic-adhered soil sample was collected aseptically from the dumpsite and transferred to the Aquatic Science Laboratory, Uva Wellassa University of Sri Lanka. The serially diluted soil sample was inoculated into Bushnell and Haas agar media, using PET powder as the sole Carbon source. Seven morphologically distinct bacterial isolates were obtained, and four (WA1, WA2, W43, and W44) were selected for biodegradation assays based on colony characteristics. PET degradation efficiency was determined using a one-month weight loss assay, where bacterial isolate W43 exhibited the significantly highest degradation percentage ($0.375 \pm 0.098\%$), ($P < 0.05$) compared to the control, indicating active polymer degradation. Molecular identification of isolate W43 based on 16S rRNA gene sequencing (primers 341F/806R) and BLASTn analysis revealed 99% sequence similarity with *Acinetobacter indicus*. Phylogenetic tree construction by maximum likelihood with 1000 bootstrap replicates in MEGA11 confirmed the isolate grouping within the *Acinetobacter* clade and showed a close genetic association with *A. indicus*, by confirming their molecular identity and evolutionary linkages. Although *A. indicus* has been reported in only a few studies as a potential plastic-degrading bacterium, this research provides novel molecular confirmation of its presence in dumpsites in Sri Lanka and its ability to degrade PET under laboratory conditions. The findings highlight *A. indicus* as a promising candidate for future biotechnological applications towards eco-friendly plastic waste management approaches.

Keywords: *Acinetobacter* spp.; dumpsite; PET biodegradation; plastic pollution; 16S rRNA



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Enumeration of Beneficial Microorganisms in Rice Rhizosphere under Different Nutrient Management Conditions

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Long-term fertilizer application profoundly influences soil chemistry and microbial ecology, yet limited evidence exists on how different nutrient regimes affect beneficial microbial communities in Sri Lankan rice ecosystems. This study investigated long-term nutrient management systems on beneficial rhizosphere microorganisms, soil physicochemical properties, and the vegetative growth of the Bg 358 rice variety at the Rice Research and Development Institute, Bathalagoda. Four treatments were compared: No fertilizer (T1), Department of Agriculture (DoA) recommended organic fertilizer (T2), DoA recommended chemical fertilizer (T3), and an Integrated Plant Nutrient System (IPNS, T4). Microbial enumeration was conducted through serial dilution and plating on nutrient agar, Jensen's agar, and Pikovskaya's media across seven crop growth stages. Data were analyzed using two-way ANOVA followed by Tukey's honestly significant difference test in SAS 9.2 software. Results showed significant interaction between stage and treatment for Total Microorganisms (TMO, $P < 0.001$), Nitrogen Fixing Bacteria (NFB, $P < 0.001$), and Phosphate Solubilizing Bacteria (PSB, $P < 0.002$). At Stage 1, T2 recorded the highest TMO ($2.33 \pm 0.65 \times 10^7$ CFU/g), NFB ($3.43 \pm 0.60 \times 10^6$ CFU/g), and PSB ($3.67 \pm 2.08 \times 10^5$ CFU/g), while T3 and T1 recorded low TMO values of $6.34 \pm 0.05 \times 10^6$ CFU/g and $4.67 \pm 0.1 \times 10^6$ CFU/g, respectively. During the mid-season (S3-S4), in IPNS, microbial activity increased, indicating possible synergistic effects of combined inputs. During stage 7, IPNS sustained the highest NFB ($1.97 \pm 0.15 \times 10^6$ CFU/g) and PSB ($8.33 \pm 1.52 \times 10^4$ CFU/g) and maintained elevated TMO ($1.30 \pm 0.26 \times 10^7$ CFU/g), whereas T3 showed suppressed microbial abundance (NFB = $5.33 \pm 1.53 \times 10^5$, PSB = $4.00 \pm 1.00 \times 10^4$ CFU/g). Soil analyses showed that T4 at stage 7 maintained near-neutral pH (6.72 ± 0.09), higher organic matter ($4.97 \pm 0.20\%$), available phosphorus (46.42 ± 4.67 mg/kg), and exchangeable potassium (42.99 ± 8.05 ppm). Plant growth responses were strongest under T4, producing about 7.50 ± 2.07 L/hill, neutral reading in SPAD meter (44.30 ± 1.91), and leaf color chart (4.00 ± 0.00). Overall, IPNS provided the best balance between plant growth, microbial population, and soil health, recommending integrated nutrient strategies for sustainable rice ecosystems in Sri Lanka.

Keywords: Beneficial microorganisms; integrated plant nutrient system; nitrogen-fixing bacteria; phosphate-solubilizing bacteria; rice rhizosphere



Paper ID: NSALS '26-204 (Oral)

Molecular Identification of Trevallies (*Caranx* spp.) in Sri Lanka using COI Gene Sequences

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Trevallies (*Caranx* spp., family Carangidae) are ecologically and economically significant fish in the coastal ecosystems of Sri Lanka. However, species level identification remains problematic due to overlapping morphological traits. This study aimed to resolve this taxonomic ambiguity using DNA barcoding based on mitochondrial Cytochrome Oxidase I (COI) gene sequencing. Fresh fish specimens were collected from twelve major fish landing sites representing the southern (Galle, Matara, Hambantota), western (Kalpitiya, Negombo, Beruwala), northern (Jaffna, Mullaitivu, Mannar), and eastern (Trincomalee, Walachchenai, Arugam Bay) coasts of Sri Lanka. Muscle tissue samples were obtained, and genomic DNA was extracted using the MasterPure Genomic DNA Extraction Kit. The COI gene region was amplified using the universal FishF1 (5'-TCAACCAACCACAAAGACATTGGCAC-3') and FishR1 (5'-TAGACTTCTGGGTGGCCAAAGAATCA-3') primers and sequenced for species identification. For phylogenetic reconstruction, a total of 31 COI sequences were analyzed, comprising twelve individuals each of *C. ignobilis* and *C. sexfasciatus*, six individuals of *C. heberi*, and one individual of *C. tille*, selected based on availability to represent all major coastal regions. High-quality sequences were edited and aligned, and species identification was confirmed using BLASTn with a $\geq 98.5\%$ similarity threshold, followed by maximum likelihood phylogenetic analysis in MEGA 12. All four species formed well-supported monophyletic clades, indicating clear species boundaries. Specimens clustered by species rather than geographic origin, suggesting a lack of detectable geographic genetic structuring based on COI data. *C. ignobilis* and *C. sexfasciatus* were the most frequently encountered species, whereas *C. heberi* and *C. tille* were comparatively rare. Overall, DNA barcoding effectively resolved species-level identification challenges among *Caranx* spp. in Sri Lankan waters and provides a reliable baseline for taxonomic validation, fisheries management, and future population genetic studies.

Keywords: *Caranx* spp.; DNA barcoding; fisheries management; phylogenetic identification



Paper ID: NSALS '26-223 (Oral)

AI-enhanced Population Forecasting Models for Effective Management of Arthropod Pests: A Case Study in Haplodiploid Spider Mites (*Tetranychus ludeni*)

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Effective management of haplodiploid Spider mites (*Tetranychus ludeni*) (Arachnida: Acari) remains a major agricultural challenge due to their complex, non-linear population dynamics, which are inadequately addressed by traditional Integrated Pest Management strategies relying on static thresholds. This study presents the development and evaluation of an integrated AI-driven decision support system for proactive pest management. The proposed system consists of three core modules: (1) a computer vision module employing a lightweight YOLOv8 Nano model for automated mite detection and counting; (2) a population prediction and forecasting module using machine learning and deep learning techniques; and (3) a web-based advisory system that delivers actionable recommendations to agricultural instructors based on a static economic injury level. The study utilizes real observational population data collected under controlled experimental conditions, supplemented with synthetically generated data to address data sparsity and improve model generalization for forecasting tasks. Exploratory data analysis confirmed strong non-linearity and density-dependent feedback effects in mite population growth. For temporal population forecasting, both statistical and learning-based time-series models were assessed, including ARIMA and LSTM. Although mite populations exhibit seasonal tendencies, classical time-series models showed limited robustness due to short time horizons, non-stationarity, and sensitivity to data volume. In contrast, a Random Forest model trained time-series features and tested on real data achieved superior performance ($R^2=0.87$), indicating stronger adaptability to non-linear biological dynamics. These results demonstrate that machine-learning-based models provide more reliable forecasts than traditional time-series approaches under data-constrained biological settings. The integrated system highlights key challenges in biological forecasting, including limited longitudinal data, noise in observational measurements, adaptive reproductive behaviour, and seasonal variability. Despite these challenges, the proposed framework demonstrates strong potential as a scalable and automated pest management tool. Future work will focus on incorporating environmental variables and adaptive economic thresholds to further improve forecasting accuracy and field-level applicability.

Keywords: Artificial intelligence, computer vision, pest management, *Tetranychus ludeni*



Paper ID: NSALS '26-224 (Oral)

Diversity of Wild Macrofungi in the Mid-country (IM1a) and Up-country (IU3c) Intermediate Zones of the Badulla District, Sri Lanka

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Macro-fungi are the fungi that produce fruiting bodies, which exceed 1 mm in size and are visible to the naked eye. Sri Lanka's diverse ecosystems support rich macro-fungal biodiversity, much of which remains unexplored. Especially the diversity, taxonomy, and phylogenetic positions of macro-fungi are poorly known in the Badulla district, Sri Lanka. This study aims to identify and characterize the wild macro-fungi from the Mid-country (IM1a) and Up-country (IU 3c) Intermediate Zones in Badulla district, Sri Lanka. The macro-fungi samples were collected based on their presence and site accessibility. Macro and micromorphological characteristics of fruiting bodies were examined for species identification. Micromorphological observations were made using an optika vision light microscope. The macro-fungal samples were cultured on PDA medium under aseptic conditions for further studies. The DNA extraction was done for five selected samples, belonging to the genera *Lepiota*, *Lepista*, *Russulla*, and *Cortinarius*. They were submitted to a commercial sequencing service provider for PCR amplification and sequencing. A total of 30 wild macro-fungi samples were collected from the study area. A majority of these samples (86.66%) were collected from the IU3c. Collected macro-fungi samples belonged to three main orders, 15 families, and 24 genera. Order Agaricales (70%) comprised of 13 families and 19 genera, represented the majority of collected samples. Polyporales (23%) represented the second largest order, including 1 family and 4 genera. Finally, the order Russulales (7%) comprised a single genus. Among all macro-fungi samples collected, the genus *Lentinus* (13.33%) was the most prominent, followed by *Lepiota* (6.7%) and *Russula* (6.7%). Other genera, such as *Agaricus*, *Amanita*, *Psilocybe*, and *Trametes*, were represented by single occurrences (3.3% each), highlighting the high taxonomic diversity in the area. Molecular identification of the selected five samples is underway. Overall, this research provides valuable insights into the diversity of wild macro-fungi in the Badulla district, emphasizing the importance of documenting regional fungal diversity in the area. Macro-fungi recorded from the study area also shows potential economical importances in terms of edible and medicinal values, further studies are required to explore their full potential.

Keywords: Agaricales; *Lentinus*; macro-fungi diversity; polyporales; Uva province



Paper ID: NSALS '26-226 (Oral)

Isolation and Characterization of Coprophilous Micro-fungi from Asian Elephant (*Elephas maximus*) Dung in Sri Lanka

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Coprophilous fungi are key decomposers in terrestrial ecosystems; however, the diversity associated with Asian elephant (*Elephas maximus*) dung in Sri Lanka is poorly documented, with most prior work limited to morphology-based identifications. The main objective of this research was to isolate and characterize micro-fungi colonizing elephant dung from dry-zone wildlife reserves in Sri Lanka and to assess their taxonomic diversity and potential ecological roles. Fresh dung was sampled from Keerthibandarapura, Rantembe and Ulhitiya. Fungi were isolated via serial dilution and direct plating on Potato Dextrose Agar (PDA). Macro and micro-morphological features were documented. Molecular identification employed ITS rDNA sequencing, NCBI-BLAST searches and phylogenetic analyses by the maximum likelihood method. According to the results, 17 different isolates were recovered, where Mucoraceae dominated the culture collection (~53% of isolates). ITS sequencing of six representative isolates resolved five species *viz.* *Fusarium proliferatum*, *Mucor irregularis*, *Penicillium sumatraense*, *Rhizopus arrhizus*, and *Trichoderma harzianum*. Notably, *Mucor irregularis* and *Rhizopus arrhizus* are documented here for the first time from an environmental (non-clinical) substrate in Sri Lanka, revealing these taxa may also function as natural saprobes contributing to dung decomposition. The detection of the plant pathogen *F. proliferatum*, suggests dietary introduction. The presence of efficient decomposers such as *T. harzianum* and *P. sumatraense*, which produce cellulase and amylase, demonstrates the strong enzymatic capacity of the dung mycobiome. This is the first systematic Asian elephant dung micro-fungal study using morphological and molecular tools in Sri Lanka. *P. sumatraense* is reported here as a first record for Sri Lanka. These results expand national fungal biodiversity records and highlight how megafauna conservation safeguards reservoirs of microbial diversity and their ecosystem functions.

Keywords: Ascomycota; dung mycobiome; fungal diversity; ITS rDNA; Mucoraceae



ANIMAL PRODUCTION AND TECHNOLOGY

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Paper ID: NSALS '26-028 (Oral)

Comparative Evaluation of Mulato II, Ryegrass, and Kikuyu Grass for Biomass Yield and Nutritive Value at Different Harvesting Stages under Highland Conditions in Sri Lanka

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Dairy farming is a vital sub-sector in Sri Lanka; however, more than half of the national milk demand is met through imports. The low adoption of improved forage varieties, together with the lack of region-specific forage performance data, has restricted the domestic milk production. This study assessed the fresh biomass yield and nutritive value of Mulato II (*Brachiaria ruziziensis* × *B. decumbens* × *B. brizantha* cv. Mulato II), Ryegrass (*Lolium perenne*), and Kikuyu grass (*Pennisetum clandestinum*) at different harvesting stages under highland conditions. The experiment was conducted at Bopaththalawa NLDB farm and the experimental design was Randomized Complete Block Design with three replicates. Mulato II and Kikuyu were established by root splits, while Ryegrass was directly sown, and standard agronomic practices were applied throughout the forage crop management. Forages were harvested at 6, 8, and 10 weeks after planting using 1 m² quadrats and the fresh biomass yield was recorded. Forage samples were analyzed for dry matter (DM), crude protein (CP), crude fat, ash, organic matter (OM), and fiber fractions [Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF)] following standard wet chemistry procedures (AOAC, 2016). Kikuyu produced the highest fresh biomass yield ($P < 0.05$), leaf yield ($P < 0.05$), and ash content ($P < 0.05$), while Mulato II recorded the highest DM ($P < 0.05$) and CP ($P < 0.05$) at every harvesting. Ryegrass exhibited the highest OM ($86.28 \pm 0.29\%$, $89.71 \pm 0.21\%$ and $90.18 \pm 0.32\%$ at week 6, 8 and 10, respectively) ($P < 0.05$), NDF content ($44.78 \pm 0.59\%$, $46.41 \pm 0.42\%$ and $48.25 \pm 0.72\%$ at 6, 8 and 10 weeks, respectively) ($P = 0.036$) and ADF content ($31.95 \pm 0.17\%$, $34.29 \pm 0.31\%$ and $36.14 \pm 0.49\%$ at 6, 8 and 10 weeks, respectively) ($P = 0.036$) among the three forage species, irrespective of the stage of harvesting. Across forage species, CP declined, and fiber content increased with advancing maturity ($P > 0.05$). Harvesting at 10 weeks after planting produced the highest biomass yield with nutritive quality across all species. In conclusion, Mulato II demonstrated the greatest promise for highland dairy systems based on the dry matter yield and the overall nutritional quality, while Kikuyu and Ryegrass provided competitive benefits in biomass production and fiber content.

Keywords: Cattle feeding; forage quality; forage yield; nutritive value; pasture grass



Paper ID: NSALS '26-039 (Oral)

Development of Fermented Low-cost Total Mixed Ration using Agricultural By-products for Dairy Cattle

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Dairy cattle productivity in Sri Lanka is constrained by the high cost and limited availability of conventional feed resources. Agricultural by-products offer a promising alternative; however, their use in formulating fermented total mixed rations (FTMR) remains underexplored. This study aimed to develop a cost-effective FTMR using locally available forages and agricultural by-products. Four total mixed rations were formulated under a completely randomized design: a control containing improved forages, commercial cattle feed, and vitamin–mineral mixtures, and three treatments (T1, T2 and T3) in which commercial feed was partially replaced by different combinations of agricultural by-products (banana peel, dahl husk, cassava peel and broken rice). All TMR formulations met the nutritional requirements for 12-month-old dairy heifers (average body weight 250 kg) according to National Research Council standards. The mixtures were packed in polythene bags, sealed, and stored anaerobically at room temperature for four weeks. Fresh and fermented TMR samples were analyzed for proximate composition [dry matter (DM), crude protein (CP), ether extract (EE), acid detergent fiber (ADF), neutral detergent fiber (NDF), and ash], while fermented samples were also evaluated for fermentation quality (pH and ammonia nitrogen). Both fresh and fermented control FTMRs recorded the highest DM (42.3%, $P=0.002$), EE (8.3%, $P=0.008$), and CP (11.6%, $P=0.003$) contents, with lower ADF (33.4%) and NDF (43.4%) values ($P=0.018$ and $P=0.001$, respectively). Nevertheless, all by-product-based FTMRs met the required nutritional standards for 12-month-old dairy heifers (average body weight 250 kg). Fermentation improved nutrient availability, pH and ammonia nitrogen values remained within acceptable limits without significant variation ($P>0.05$). The inclusion of agricultural by-products reduced the cost of production by 16%. These findings indicate that FTMRs can be effectively developed from locally available agricultural by-products, offering a nutritionally adequate and economically viable feeding strategy for dairy production in Sri Lanka.

Keywords: Cost-effective feed, dairy cattle; ensiling; feed formulation; local forages



Paper ID: NSALS '26-045 (Oral)

Consumer Acceptance and Perception of Meat Alternatives among University Students in Sri Lanka

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The growing global population, combined with environmental concerns and animal welfare issues, has increased the worldwide demand for sustainable protein sources, leading to rising interest in meat alternatives. However, only few studies have focused on consumer acceptance of meat alternatives in developing countries such as Sri Lanka. This research examined consumer acceptance and the factors influencing perception and adoption of willingness to use meat alternatives among university students. A pre-tested structured questionnaire was applied to carry out the survey in State Universities through the snowball sampling method with 315 undergraduates. The study focused on the relationship between awareness, perception, social and cultural acceptance, health and environmental concerns, and sensory and price perception with the willingness to adopt meat alternatives. Statistical analysis included descriptive statistics, correlation analysis, and multiple linear regression (MLR) to identify significant predictors of willingness to adopt the meat alternatives using SPSS version 27. The MLR model explained 61.6% of the variance in willingness to adopt meat alternatives ($R^2=0.616$). The findings confirmed that the adoption decision is significantly predicted by cultural acceptance ($\beta=0.261$, $P<0.001$), which was the strongest predictor. Other statistically significant positive predictors were perception ($\beta=0.232$, $P<0.001$), social influence ($\beta=0.194$, $P<0.001$), sensory and price perception ($\beta=0.175$, $P=0.001$), and environmental concerns ($\beta=0.120$, $P=0.024$). Knowledge and health consciousness were found to be non-significant predictors. These results highlighted that Sri Lankan market differs from western markets, where environmental and health considerations are typically dominant. Additionally, the findings revealed a significant gap between awareness (85%) and actual trial behavior (45%). This study provides a valuable insight for food manufacturers and policymakers, with the implication that successful market penetration depends on the availability of culturally adapted products combined with experiential marketing strategies to bridge the awareness-to-trial gap.

Keywords: Adoption decision; cultural acceptance; multiple linear regression; price perception; social influence; sustainable protein



Paper ID: NSALS '26-059 (Oral)

Effect of Storage duration on Nutrient Composition of Rice Polish at Different Three Regions under Room Temperature Condition

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Rice polish, a main by-product of the rice milling industry is vastly being used in poultry and livestock feeds due to its higher nutritional value and lower cost. The nutritional quality deteriorates with the storage causing decline in feed quality. This study investigated the effect of storage time on the composition of rice polish collected from Ampara, Buttala and Anuradhapura areas under room temperature condition. The objectives were to assess changes in moisture, crude protein, crude fat, crude fiber, and ash contents over a 45-day storage period and to compare the influence of storage duration and geographical origin on nutrient composition. Rice polish samples were collected from each of the three different regions: Ampara, Buttala and Anuradhapura. Samples were collected at the packaging stage using a hand probe, which was inserted horizontally three times (upper part, middle part, and lower part) into the bag from one corner to the opposite corner. Four samples (1 kg sample/bag) were collected for per region. The collected samples were homogenized and stored in woven polypropylene bags according to the sample collected location for 45 days. Proximate composition was analyzed on day 1, 15, 30, and 45 using standard methods (SLS). All the analyses were done using three replicates of each sample. Data were analyzed using factorial ANOVA design in Minitab software. Results revealed that both storage duration and location had significant effects ($P<0.05$) on nutrient composition. Moisture content increased ($P<0.01$) steadily (9.36 ± 0.08 to 10.49 ± 0.08), while crude protein and crude fat were reduced ($P<0.01$) by an average of 4.54% and 10.88% respectively. Fiber content was decreased ($P<0.01$) from 15.41 ± 0.26 to 12.90 ± 0.26 (day 1-15) but increased thereafter to 16.13 ± 0.26 by day 45. Ash content showed a slight increment ($P<0.01$), from 9.81 ± 0.06 to 10.26 ± 0.06 for 45 days storage period. In conclusion, moisture content and ash content were increased significantly during storage. Crude protein and crude fat declined, especially within the first 15 days. Crude fiber had no significant interaction ($P=0.221$) with storage duration and location.

Keywords: Ash content; crude fat; crude protein; moisture content; rice polish; storage duration



Paper ID: NSALS '26-064 (Oral)

Effect of Conditioning Temperature on Moisture Loss and Quality of Broiler Finisher Feed Pellets

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Pelleting is an important step in making poultry feed. Pelleting improves feed handling, reduces waste, and increases nutrient utilization. This study investigated the effect of conditioning temperatures (78°C, 80°C, and 82°C) on moisture loss and pellet quality of broiler finisher feed. The experiment was conducted at a commercial feed mill using a completely randomized design with three temperature treatments and four replicates per treatment. Finisher feed was pelleted at each conditioning temperature, and moisture loss during cooling, pellet physical quality parameters such as Pellet Durability Index (PDI) and chemical composition (crude protein, fat, fiber, and ash) were evaluated. Data were analyzed using one-way ANOVA at a significance level of $\alpha=0.05$. Results showed that higher conditioning temperatures significantly decreased pellet moisture loss and improved PDI, with the 82°C temperature relented the lowest ($P<0.05$) moisture loss and highest ($P<0.05$) PDI in finisher feed. However, pellets conditioned at 82°C had slight reductions in crude protein, fat, fiber content and no negative effects ($P<0.05$) on ash content compared to lower temperatures. These findings recommend that conditioning at 80-82°C provides the best balance between enhancing physical pellet quality and maintaining nutrient unity in broiler finisher feed. In conclusion, optimizing conditioning temperature in the pelleting process causes to minimizing moisture loss while maximizing pellet durability, thereby improving feed efficiency and shelf life.

Keywords: Broiler finisher; chemical composition; conditioning temperature; feed pelleting; moisture loss; pellet durability index



Paper ID: NSALS '26-082 (Oral)

Effect of Moisture, Toxin Binder and Acidifier on Aflatoxin Contamination in Corn at a Commercial Feed Mill

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Aflatoxin contamination in corn causes significant challenges to commercial feed mills, requiring effective control strategies that address varying moisture conditions. This study investigated the interactive effects of moisture content, toxin binder application, and acidifier treatment on total aflatoxin levels in corn under controlled conditions simulating commercial feed mill storage environments. A completely randomized factorial design was applied with three moisture levels (low-12%, medium-15%, high-18%), three treatments (control, toxin binder only at 2.0 g/kg, and toxin binder+acidifier combination at 2.0 g/kg+2.50 g/kg respectively), and four replicates from one combination (n=36). Ground corn samples were stored at 25±2°C and 85±5% relative humidity for 10 days. Total aflatoxin levels were quantified using lateral flow immunochromatographic test strips with a 3PR mini reader system at day 3 and day 10. Moisture content showed a significant aflatoxin development in corn, with high moisture samples (18%) than low moisture samples (12%) ($P=0.000$). Treatment effectiveness was significantly varied by moisture level ($P<0.01$). At day 10, the toxin binder+acidifier combination achieved 47.0% reduction under high moisture conditions and 40.1% reduction under low moisture conditions compared to the control samples ($P<0.01$). Results indicated that the moisture-dependent treatment strategies are essential for optimal aflatoxin control in commercial feed mills. The combined treatment approach provides advanced benefits under high-risk moisture conditions, while single treatments may be sufficient under moderate moisture level conditions. These findings support the establishment of adaptive management strategies that improve the treatment selection based on receiving corn moisture characteristics.

Keywords: Acidifier; aflatoxin; corn; moisture content; mycotoxins; toxin binder



Paper ID: NSALS '26 -090 (Oral)

Effectiveness of Charcoal and *Terminalia catappa* Leaves as Bedding Material for Production Performance and Welfare of Poultry

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The poultry industry faces significant challenges in maintaining the health and productivity of birds in hot weather. Good litter management is crucial for maintaining poultry health and performance, especially in high temperatures. This study aimed to evaluate and compare the effects of using Catappa leaves and charcoal together as litter amendments. The study followed a completely randomized design with five litter treatments replicated twice. A well-ventilated room divided into five cages was used, where each cage contained four birds, with a total of (n=40) day-old native chicks. Litter treatments consisted of a control, represented by sawdust (T0), 100% dry Catappa leaves (T1) and charcoal (0.25 kg/m²), which was mixed with dry Catappa leaves at inclusion levels of 10% (T2), 20% (T3), and 30% (T4). Birds were brooded on rice husk for the first two weeks and then assigned to treatments based on average body weight. All cages were maintained at a uniform litter depth of 5 cm and provided 0.09 m² floor space per chick. Feed and water were offered ad libitum. Data collection included production performance, litter quality analysis, welfare parameters and selected behavioral observations. The study showed that 30% charcoal and 70% Catappa leaf litter can effectively replace sawdust, with similar feed intake (783.85 vs. 783.07 g) and FCR (0.69 vs. 0.68), reduced ammonia (19.13 vs. 22.5 mg/g), and improved welfare behaviors (higher feeding and foraging, lower resting). In conclusion, the litter treatment containing 30% charcoal and 70% Catappa leaves showed better performance, welfare, and litter quality parameters comparable to sawdust, with no significant differences ($P>0.05$), indicating its potential as a sustainable alternative bedding material for poultry under hot climatic conditions.

Keywords: Ammonia; behavioral assessment; footpad lesions; litter temperature; sawdust; sustainable



Paper ID: NSALS '26-102 (Oral)

Quality Assessment of Corn Grain Collected from Two Different Regions in Sri Lanka

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Corn (*Zea mays* L.) is a principal energy source used in the feed industry, yet region-specific data on corn grain quality in Sri Lanka remain limited. This research highlights its importance by providing baseline regional corn quality data for Sri Lanka. This study compared physical and proximate quality characteristics of corn grain collected from the Anuradhapura, and Ampara-Monaragala regions. A total of 144 representative samples (72 per region) were analyzed. Physical grading followed USDA standards (sound seeds, moldy seeds, immature seeds, broken seeds, other color seeds, weevilled seeds, foreign matter) using 100 g subsamples, while proximate composition (moisture, crude protein, crude fat, crude fiber, and ash) was determined by Near-Infrared Reflectance Spectroscopy. Statistical differences between regions were tested using one-way ANOVA (significance at $P < 0.05$). Anuradhapura contained a higher proportion of sound seeds ($88.47 \pm 3.08\%$ vs. $86.67 \pm 4.38\%$; $P = 0.005$) and lower moisture ($13.54 \pm 0.74\%$ vs. $14.55 \pm 1.17\%$; $P < 0.01$) than Ampara-Monaragala region. Moldy seeds ($4.83 \pm 2.23\%$ vs. $5.74 \pm 2.85\%$; $P = 0.036$), immature seeds ($3.07 \pm 1.55\%$ vs. $4.08 \pm 2.03\%$; $P = 0.001$), broken seeds ($2.92 \pm 1.53\%$ vs. $2.24 \pm 1.49\%$; $P = 0.008$), other color seeds ($0.15 \pm 0.43\%$ vs. $0.49 \pm 1.01\%$; $P = 0.011$), and foreign matter ($0.31 \pm 0.49\%$ vs. $0.63 \pm 0.78\%$; $P = 0.004$) also differed between regions. No significant difference was observed for weevil-attacked seeds ($0.11 \pm 0.32\%$ vs. $0.11 \pm 0.55\%$; $P = 1.00$). Among proximate components, crude fiber ($3.39 \pm 0.42\%$ vs. $3.54 \pm 0.31\%$; $P = 0.016$) and ash ($1.42 \pm 0.07\%$ vs. $1.45 \pm 0.06\%$; $P = 0.027$) were higher in Ampara-Monaragala region, while crude protein and crude fat showed no significant regional differences. Anuradhapura corn had superior physical quality, with higher sound seed proportions and lower moisture content, and other physical quality traits also demonstrate clear regional differences in overall grain quality. The observed differences in proximate content may be attributed to regional variations in climatic conditions. Collectively, Anuradhapura samples exhibited superior physical quality and lower moisture and ash levels, indicating better storage stability and suitability for feed formulation. These findings provide preliminary insights that can guide future research and improvements in corn quality.

Keywords: Corn quality; near-infrared reflectance spectroscopy; physical quality; proximate composition



Paper ID: NSALS '26-112 (Oral)

Occurrence and Distribution of Microplastics in Broiler Meat along Commercial Processing Stages: A Case Study from Sri Lanka

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Microplastics (MPs), defined as plastic particles smaller than 5 mm, have become a significant global concern in food safety due to their potential adverse effects on human health and the integrity of the food supply chain. However, scientific evidence on MPs contamination in broiler meat in Sri Lanka remains scarce. This study investigated MPs occurrence and distribution in broiler meat across four key processing stages: post-evisceration, post-screw chilling, post-portioning, and post-packaging in a commercial processing plant. Breast meat samples from each stage (n=3) were collected and digested with 10% KOH at 60°C, followed by density separation using saturated NaCl solution, and subsequently filtered under vacuum through 1.2 µm microfiber filters. Extracted MPs were microscopically screened under a stereomicroscope, verified using the host needle test, and characterized based on size, morphotypes, and color. Fourier Transform Infrared Spectroscopy was used to determine the polymer types of extracted MPs. MPs were detected in all samples, confirming contamination throughout the processing chain, with mean concentrations of 129±15, 101±12, 83±10, and 68±8 MPs/kg at the post-evisceration, post-screw chilling, post-portioning, and post-packaging stages, respectively ($P<0.05$). The highest contamination at post-evisceration indicates that early processing steps involving intensive water use and equipment contact with MPs may be the major contributors. Fibers were the predominant morphotype (~64%), followed by fragments (~29%) and films (~7%), with blue and black as the most frequent color categories. Tiny particles (<1 mm) are more abundant (66%), followed by 1-2 mm (19%), and >2 mm (15%) size classes. Identified polymers included low-density polyethylene, polyethylene terephthalate, and polypropylene, collectively accounting for over 80% of the detected MPs, implicating processing equipment, water, and packaging materials as potential key contamination sources. These findings revealed critical contamination hotspots along the processing chain and emphasized the need for improved equipment materials, regular water quality monitoring, and enhanced hygienic practices to minimize MPs contamination and ensure food safety in the poultry industry. Future studies with larger sample sizes and multiple processing facilities are recommended to validate these findings and provide a more comprehensive understanding of MPs contamination in broiler meat.

Keywords: Broiler processing; food safety; fourier transform infrared spectroscopy; microplastic contamination; post-evisceration



Paper ID: NSALS '26-115 (Oral)

Analysis of Factors Influencing Poultry Production in Kilinochchi District

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Poultry production is an important contributor to rural income, employment, and nutritional security. However, poultry farmers in Kilinochchi district face several challenges, including high feed costs, disease outbreaks, inadequate technical knowledge, lack of organized marketing cooperatives and price volatility which reduce productivity and profitability. This study was conducted to identify the key socio-economic, farm management, technological, and market-related factors influencing poultry production in Kilinochchi district. Primary data were collected from 120 poultry farmers across four Divisional Secretariat Divisions using a structured questionnaire. Data was analyzed using descriptive statistics, correlation analysis, and multiple linear regression models with SPSS software to determine the significant factors affecting production outcomes. Results revealed that farmer experience ($P<0.01$), land size ($P<0.05$), and feed quantity ($P<0.10$) had significant positive effects on monthly income, whereas energy cost ($P<0.05$) had a significant negative effect. Egg production was significantly influenced by farmer experience and land size ($P<0.01$), feed quantity ($P<0.05$), while labour man-days and energy cost were negatively significant ($P<0.05$). Number of birds sold was negatively affected by farmer experience and land size ($P<0.05$), and primary income source ($P<0.01$), but was positively associated with labour man-days ($P<0.01$). Moderating effects of farmer ability and policy were observed, with policy \times education ($P<0.05$) and policy \times feed cost ($P<0.05$) showing significant negative impacts, farm ability \times market access was positive but not statistically significant ($P>0.10$). The study concludes that poultry production in Kilinochchi can be substantially improved through better access to affordable feed, farmer training programs, and supportive policy frameworks. Strengthening extension services, improving credit systems, and enhancing market linkages are recommended to ensure sustainable growth of poultry farming, thereby improving rural livelihoods and regional food security.

Keywords: Kilinochchi district; market access; poultry production; socio-economic factors; technology adoption



Paper ID: NSALS '26-138 (Oral)

Development, Stability Assessment and Sensory Evaluation of Probiotic Enriched Dairy based Egg Spread

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The growing demand for functional foods has driven the development of innovative products that combine nutritional value with probiotic health benefits. This study aimed to develop a novel probiotic-enriched, egg-incorporated dairy spread. The development of an egg-dairy-probiotic product represents combination of high-quality proteins and essential nutrients from eggs with the probiotics and nutritional benefits of dairy. Such a formulation would offer a balanced source of bioavailable proteins, vitamins, and minerals while supporting gut health and immunity through probiotic incorporation. The methodology involved preparing whole egg powder via spray drying and creating a dairy spread from dairy cream, followed by the incorporation of a *Streptococcus thermophilus* pre-culture into the dairy spread, which was then incubated at 42°C for 4 hours to allow probiotic activation and fermentation before storage. Three concentrations of egg powder (2, 3, and 4%) were added to assess their impact on the final product. The formulated spreads were analyzed for proximate composition, physicochemical properties (pH, DPPH radical scavenging activity, lipid oxidation by thiobarbituric acid reactive substances assay), texture, and microbiological stability over a 21-day refrigerated storage period. The results showed that increasing egg powder concentration significantly improved the protein content of the product. Probiotic viability was maintained above the recommended therapeutic level ($\geq 10^8$ CFU/g), as defined by the FAO/WHO for probiotic efficacy, across all formulations throughout the storage period, confirming the product's potential functional health benefits. The incorporation of egg powder enhanced the antioxidant activity of the dairy spread, with DPPH radical scavenging activity at day 21 increasing from 56.54±9.03% in the control to 66.40±13.77%, 79.9±21.4%, and 87.61±4.06% in 2, 3, and 4% in egg powder incorporated dairy spreads respectively, indicating improved oxidative stability during storage. Sensory analysis revealed high overall consumer acceptability for all treatments, while the three percent egg powder incorporated formulation showed the highest acceptability compared to the other formulations. This innovative fusion of probiotic-egg-dairy demonstrated the potential to develop a nutritious, stable, and value-added novel probiotic product for the functional food market.

Keywords: Dairy spread; egg powder; functional food; probiotic; *Streptococcus thermophilus*



Paper ID: NSALS '26-147 (Oral)

Assessment of Raw Milk Quality along the Nanuooya Dairy Supply Chain and Evaluation of Gel Ice Intervention at Farmer Level

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The dairy industry constitutes a significant component of Sri Lanka's economy and rural livelihoods; however, the quality of raw milk is often compromised along the supply chain due to improper handling and insufficient cooling facilities, particularly at the farm level. In the Nanuooya supply chain, evening milk is commonly stored overnight (10-11 hours) under ambient temperature (18-19°C), leading to progressive quality deterioration. This degradation mainly results from the lack of refrigeration at the farm level before delivery to the chilling center. Therefore, this study aimed to assess the raw milk quality along the Nanuooya dairy supply chain and evaluate the effectiveness of a low-cost cooling strategy for smallholder farmers in comparison with conventional storage methods. Initially, milk samples were collected from 10 farmers, two farm societies, one chilling center around Nanuooya region, and factory level to evaluate the quality of milk. Laboratory analyses included Total Colony Count (TCC), titratable acidity, resazurin test (keeping quality), and the alcohol precipitation test. Later, this study selected eight farmers in the Udaradella (Nanuoya region) to compare the effects of gel ice-assisted overnight milk storage with conventional storage. The study was conducted in two consecutive time phases: during the first phase, farmers stored their evening milk using conventional methods, where milk cans were placed in buckets of water at ambient temperature (18-19°C); during the second phase, farmers were provided with 15 gel ice packs and instructed to use them to cool the water used for immersing the milk cans. Milk stored under conventional conditions showed the poorest quality, with substantial deterioration during overnight storage. The gel ice intervention significantly reduced the average milk storage temperature from 18°C to 10°C, the average microbial load from 7.19 to 6.41 log cfu/mL, and the average titratable acidity from 0.17% to 0.15%, ($P < 0.05$). The alcohol precipitation test indicated improved milk stability, while swab analyses of inner walls of milk cans revealed hygiene deficiencies but no evidence of recent fecal contamination. Paired t-test analysis confirmed that the improvements in TCC, acidity, and temperature were statistically significant ($P < 0.05$). The findings of this study indicate that gel ice packs are an effective method for reducing microbial growth and preserving milk quality during overnight storage at the farmer level in the absence of refrigeration.

Keywords: Conventional; dairy industry; farmer level; gel ice; milk quality



Paper ID: NSALS '26-162 (Oral)

Prevalence and Epidemiological Insights of *Theileria orientalis* in Cattle from Karachchi and Kandawala Veterinary Range in Kilinochchi District in Sri Lanka: An Integrated Analysis using Microscopy and PCR

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Haemoparasitic infections represent major constraints to livestock productivity and welfare in tropical regions, causing anemia, immunosuppression, and reduced performance in affected animals. These vector-borne pathogens, primarily transmitted by ticks, include species of *Theileria*, *Babesia*, and *Anaplasma*, which collectively threaten bovine well-being and rural livelihoods. In Sri Lanka, such infections are widespread, particularly in the dry zones, where high tick abundance facilitates pathogen transmission. The Kilinochchi district in the northern province, characterized by its tropical dry climate and predominantly extensive and semi-intensive cattle management systems, provides a highly favorable environment for the spread of tick-borne haemoprotozoa such as *Theileria orientalis*. The present study, conducted from May to October 2025, aimed to determine the prevalence of *T. orientalis* in cattle from two veterinary ranges, Karachchi and Kandawalai, within the Kilinochchi district. We randomly collected 160 samples from 50 farms across both veterinary ranges. The farms were selected based on previous reports of infection and their management practices to ensure representative sampling. Of the 160 samples, indigenous cattle included 35 from Karachchi and 39 from Kandawala, while crossbred cattle included 45 from Karachchi and 41 from Kandawala. This distribution allows a valid comparison of prevalence between breeds and locations that were examined microscopically, with *Theileria* piroplasms observed in 49 samples, corresponding to an overall microscopy prevalence of 30.6%. These 49 smear-positive samples were subsequently subjected to species-specific PCR targeting the major piroplasm surface protein (MPSP) gene of *T. orientalis* using primers TO-MPSP-F (5'-CTTTGCCTAGGATACTTCT-3') and TO-MPSP-R (5'-ACGGCCAAGTGGTGAGAACT-3') resulting in the confirmation of 19 PCR-positive samples. PCR confirmed *T. orientalis* infection in 40% of samples from Karachchi and 37.5% from Kandawalai. The chi-square results show that there was no significant difference in infection rates between the two veterinary ranges or between the different breeds. The very low χ^2 value for ranges (0.06) means that infections were almost the same in both locations. For breeds, the χ^2 value (≈ 2.14) was also not high enough to show a real difference. This means that under the current farm conditions, neither the location nor the breed had a clear effect on the occurrence of infection. This study confirms the molecular presence of *T. orientalis* in Kilinochchi, underscoring its subclinical circulation and the need for integrated diagnostics, effective tick control, and improved herd management strategies.

Keywords: Blood smear; cattle; haemoparasite; PCR; *Theileria orientalis*



Paper ID: NSALS '26-163 (Oral)

Development of Whey-based Beverage Incorporated with Pineapple (*Ananas comosus*)

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Whey is a nutritious by-product of cheese processing, with potential for value-added applications to address sustainability challenges. Pineapple (*Ananas comosus*) offers complementary flavor, acidity, and nutritional components such as vitamin C and Bromelain, enhancing the value of whey-based applications. Therefore, the current research aimed to develop a whey-based beverage incorporated with pineapple and to evaluate its physicochemical parameters, appearance, taste, aroma, and overall acceptability, and microbiological properties. The whey-based pineapple beverage was formulated by combining sweet whey (from Mozzarella production) with pineapple pulp (10, 15, and 20%) and lemon juice (2%). The control sample consisted of a whey-based beverage without pineapple pulp addition (0%) and was optimized through preliminary trials. A sensory evaluation was conducted under control conditions (samples served at 4°C) using the nine-point hedonic scale and 30 untrained panelists. Control and 15% pineapple with sample were further analyzed for proximate composition, pH, titratable acidity, Brix value, and microbial quality over a one-month storage period. The findings of the sensory evaluation indicated that the beverage containing 15% pineapple pulp was significantly preferred ($P<0.05$). Results further revealed that the 15% pineapple pulp added beverage sample had the lower fat (1.10%), protein (1.07%), and fiber (0.45%) contents compared to the control sample (0% pineapple pulp) ($P<0.05$). Acidity increased while pH decreased during storage. The Brix value of both the control and the pineapple-added whey beverage gradually decreased throughout the 4-week storage period. The observed pH, Acidity and Brix value during storage are consistent with the findings of previous research. Total Plate counts increased significantly ($P<0.05$). Over the storage period and in the final product after preparation, *Escherichia coli* were absent in all samples. While yeast and mold counts are present at low levels. The incorporation of pineapple pulp enhanced the functional, microbial, and storage stability aspects of the whey-based beverage, supporting its potential as a value-added dairy product.

Keywords: Physicochemical properties; pineapple pulp; sensory evaluation; whey beverage



Paper ID: NSALS '26-164 (Oral)

Effects of Handling Practices and Environmental Enrichment on Welfare and Productivity of Aseel Chickens

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Aseel chickens are a native breed in Sri Lanka, valued for their cultural and economic significance. However, typically reared under suboptimal welfare conditions that cause stress and decrease production. Stress has a negative impact on growth, plumage quality, behavior, and overall health. Welfare-friendly practices such as enhanced handling and environmental enrichment have been effective in commercial poultry production. However, they have not been extensively researched in Aseel roosters. The objective of the current research was to analyze the impact of handling improvement and environmental enrichment on the welfare and productivity of Aseel chickens. The experiment was carried out at the Trincomalee district in Sri Lanka using 24 Aseel roosters of 7 to 8 months age. The birds were separated into three groups randomly: Control (C), Handling Improvement (HI) such as consistent handling, calm movements & daily interaction, and Environmental Enrichment (EE) such as provide with various enrichment materials like toys, perches, foraging materials and each of the groups contained four replicates. The experiment lasted for eight weeks and comprised a baseline (two weeks) and a treatment period (six weeks). The welfare interventions tested were observation of behavior (aggression and pacing), physical assessment (body weight increase and feather condition), and physiological testing (blood cortisol levels). A completely randomized design with one-way ANOVA at a 0.05 significance level was used to analyze the data. The outcomes indicated that enrichment and handling both promoted welfares more effectively than the C ($P<0.05$). HI gained the highest body weight, the best feather condition, and recorded the lowest aggression and pacing scores. The EE group also improved noticeably, specifically in feather condition and a decrease ($P<0.05$) in stress-related behavior, although the effect on weight gain was less pronounced than with handling. The study concludes that environmental enrichment and gentle handling are cost- effective and feasible methods for alleviating stress and enhancing the welfare and productivity of Aseel chickens. The welfare interventions tested in this study can be practically implemented by smallholder farmers through gentle daily handling, calm human interaction, use of simple perches, provision of hanging or pecking objects, and natural foraging materials in Sri Lanka to achieve both ethical and economic benefits.

Keywords: Aseel chickens; enrichment; handling; productivity; stress; welfare



Paper ID: NSALS '26-181 (Oral)

Comparative Evaluation of Barfoed's Spectrophotometric Method and Handheld Glucometer for Dextrose Adulteration Detection in Raw Milk

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Dextrose is commonly added to raw milk as an adulterant to increase apparent solid-not-fat levels and mimic natural sweetness, allowing diluted milk to pass quality checks. This study compared Barfoed's test with Ultraviolet-Visible (UV-Vis) spectrophotometry (540 nm) against handheld glucometer analysis for dextrose quantification in raw milk. Barfoed's method measured reducing sugar absorbance post-copper reduction, while glucometer provided direct glucose-equivalent readings. Barfoed's method was performed by mixing equal volumes (3 mL) of raw milk and Barfoed's reagent, followed by heating in a boiling water bath for three minutes and immediate cooling under tap water. Subsequently, 1 mL of 1% phosphomolybdic acid was added and gently mixed. A blue-colored complex indicated the presence of reducing sugars. Absorbance was measured at 540 nm using a UV-visible spectrophotometer. Raw milk samples (n=36) were spiked with a 1% (w/v) dextrose stock solution using the $C_1V_1 = C_2V_2$ dilution formula to achieve final concentrations of 10-360 mg/dL. All samples were analyzed in triplicate under controlled conditions. Statistical analyses were performed to assess the accuracy and agreement between the two techniques. Pearson's correlation coefficient showed a strong positive relationship between glucometer readings and spectrophotometric measurements ($r = 0.905$) ($P < 0.001$). Linear regression analysis produced high R^2 values (>92%) for both methods, confirming their predictive strength. Although glucometer readings were consistently higher, the paired t-test indicated no significant difference between the methods ($P > 0.05$). Bland Altman analysis showed that most differences fell within the acceptable limits of agreement, suggesting minimal bias and good method comparability. These results suggest that the handheld glucometer is a rapid, cost effective, and practical tool for preliminary screening of dextrose adulteration in milk, especially in field settings. The Barfoed's spectrophotometric method offers greater analytical precision, making it suitable for confirmatory testing in laboratory environments. Together, these methods present complementary approaches for monitoring milk quality across diverse operational contexts.

Keywords: Barfoed's method; dextrose; handheld glucometer; milk adulteration; rapid; UV-visible spectrophotometry



Paper ID: NSALS '26-216 (Oral)

Development and Quality Evaluation of Mozzarella Cheese from a Goat and Cow Milk Blend Enriched with Sweet Potato (*Ipomoea batatas*)

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Rising consumer demand for healthier, nutrient-dense dairy products has intensified interest in developing low-fat, functional cheeses enriched with plant proteins. Traditionally, mozzarella cheese is primarily produced from buffalo' milk, which is high in fat. But compared to other cheese, mozzarella has less fat. However, there is interest in replacing a milk content with plant-based ingredients, representing a key research gap addressed in this study. The objective of the study was to develop low-fat, antioxidant-rich mozzarella cheese by blending skimmed cow and goat milk with sweet potato (*Ipomoea batatas*). Mozzarella cheese was produced from mixed skimmed milk in the ratio of cow milk: goat milk (6:4) (v/v). Sweet potato (*Ipomoea batatas*) syrup was incorporated at four levels: 0, 5, 10, and 15% (v/w). The cheese was evaluated for proximate, sensory, physicochemical, microbial, and antioxidant properties during storage at 4°C for 0, 10, 20, and 30 days. Results were analyzed using SAS (Tukey's test) ($P < 0.05$). Incorporation of sweet potato syrup significantly enhanced physicochemical and sensory properties, with 5% syrup yielding the highest sensory acceptance. Antioxidant content increased with higher syrup levels but declined during storage, likely due to the degradation of antioxidant compounds over time. Microbial counts (TPC) increased during storage but remained within safe limits under refrigeration. Moisture content decreased, leading to increased fat content. Titratable acidity of the cheese samples increased, accompanied by a corresponding decrease in pH, likely due to the fermentation of residual lactose. Further investigations, including assessments of stretchability and meltability, are recommended to determine the suitability of the product for use as pizza toppings. This innovative mozzarella cheese offers a healthier, functional alternative with enhanced nutritional properties.

Keywords: Antioxidant; cow milk; functional food; goat milk; mozzarella cheese; sweet potato



Paper ID: NSALS '26-220 (Oral)

Knowledge, Attitudes, and Practices of Meat Processing Workers toward Food Hygiene: A Case Study in Sri Lanka

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Meat processing facilities must ensure hygienic food handling to minimize contamination risks and safeguard public health. This study assessed the knowledge, attitude, and practice (KAP) of workers regarding hygienic food handling in a selected meat processing plant in Sri Lanka. A descriptive cross-sectional survey was conducted among 150 employees selected through a convenience sampling method. Data were collected using a pre-tested, structured questionnaire administered via Google Forms and analyzed using SPSS with descriptive statistics, Pearson correlation, and multiple linear regression. Majority of participants were male (55%), aged 16–25 years (38%), and possessed secondary school education. Workers demonstrated good awareness of personal hygiene (82.77±12.39) and knowledge of food hazards (81.80±11.06). Attitudinal factors, including concern level (83.23±11.41) and regulation support (79.17±12.03), reflected a favorable mindset towards maintaining hygiene standards. Practice-related factors showed high adherence to cleaning (86.17±12.03) and storage hygiene (80.73±12.16). Correlation analysis revealed significant positive relationships among KAP variables ($r=0.234-0.571$; $P<0.01$). Regression analysis indicated that level of concern ($\beta=0.352$; $P=0.002$), regular cleaning ($\beta=0.383$; $P<0.001$), and storage practices ($\beta=0.216$; $P=0.012$) significantly predicted improved hygienic behavior. The model was significant ($F=12.375$; $P<0.001$; $R^2=0.471$; Adjusted $R^2=0.433$). Overall, workers exhibited satisfactory knowledge, positive attitudes, and appropriate hygiene practices. Attitude-led interventions, continuous training, and supervisory monitoring could further enhance compliance with hygienic standards. The findings emphasize the importance of fostering a strong food safety culture in Sri Lankan meat industries to ensure consumer protection and product quality.

Keywords: Food hazards; hygiene standards; personal hygiene; public health; storage practices



Paper ID: NSALS '26-007 (Poster)

Comparison of Fish Oil Extracted Fish Waste Generated from Barramundi (*Lates calcarifer*) with Different Extraction Methods

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Among the world's fish processing industries, barramundi (*Lates calcarifer*) is a key species that generates a significant amount of waste during processing, leading to a high volume of by-products. These Fish by-products are rich in omega-3 polyunsaturated fatty acids which are highly valued in the food and pharmaceutical industry. The study was focused to optimize an effective fish oil extraction method from barramundi waste. The determined proximate crude fat composition of barramundi waste showed 12.82±0.03%. Two treatments as wet-pressing (rendering) and the solvent extraction method were used for the extraction. As the solvents chloroform/methanol (control), acetone, petroleum ether, n-hexane and ethanol were used as a single solvent and as combinations at a 1:1 (w/v) ratio (Fish sample: Solvent). The yield of fish oil and the chemical property indices (acid value) were assessed. Among the single solvent extraction methods, acetone resulted in the highest yield (5.90±0.35%) followed by petroleum ether (5.31±0.55%), n-hexane (4.82±0.31%), and ethanol (2.45±0.31%). In solvent combination extraction, the acetone/ethanol/ether mixture (1:1:1) produced the highest yield (17.25±0.51%), followed by acetone/ethanol/hexane (1:1:1) (11.68±0.79%), acetone/hexane/butanol (1:1:1) (10.88±0.21%), and chloroform/methanol/ether (1:1:1) (7.47±0.34%), ($P < 0.05$). In comparison, wet pressing method resulted in a lower oil yield 1.32±0.10%. Acid value was determined only for oil extracted using the highest yielding single solvent (acetone: 0.46±0.15), the highest yielding solvent combination (acetone/ethanol/ether combination 1.36±0.21), and wet press method (2.36±0.42). The chloroform/methanol system, used as the control, yielded 4.27±0.40% oil with an acid value of 0.70±0.20. The wet press method exhibited the highest acid value, indicating increased hydrolysis and reduced oil quality compared to solvent extracted oils from barramundi fish waste. In conclusion, solvent extraction was significantly more effective than wet pressing for fish oil recovery from barramundi processing waste, yielding higher oil recovery and superior chemical quality.

Keywords: Acid value; extraction; fish oil; *Lates calcarifer*; oil yield



Paper ID: NSALS '26-016 (Poster)

Formulation of Semi-moist Cat Food by Incorporating Industrial Byproduct Waste from Swordfish (*Xiphias gladius*) for Young Adult Cats

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Pet food industry in Sri Lanka is underdeveloped industry, and seafood-based pet foods are lacked in the local market. This study aimed to develop a nutritionally balanced semi-moist cat food for young adult cats (1-2 years) using swordfish (*Xiphias gladius*) by-products (fish oil by-products). The research was aimed to evaluate the effects of swordfish by-product included pet food on cats' palatability and overall well-being. The diet was developed in accordance with European nutritional guidelines for young adult cats. Eighteen young adult pet cats (breeds: Main Coon, British Short Hair, Persian, and Extreme Punch Face/Body weight: 3.0-4.6 kg) were divided into two groups as treatment and control. The treatment group was fed semi-moist cat food, and the control group was fed commercially available pet food. Cats were gradually adopted for the feed, and water was given adequately throughout the study. After fourteen days of adaptation period, the fecal consistency, skin and coat health, water consumption, palatability, allergic reactions, and behavioral patterns of cats were evaluated and continued for four weeks. Sensory evaluation indicated maximum scores for palatability and skin and coat condition in the treatment group, with no allergic responses observed in either group, while water intake remained within normal levels in all cats. Shelf life of the developed cat food was assessed up to six weeks through TBARs assay, DNPH, and pH analysis. There was no significant difference observed between the two groups related to the sensory parameters ($P>0.05$). The results indicated that there were no significant differences in protein oxidation (3.10 ± 1.89 to 1.78 ± 0.63), lipid oxidation (2.44 ± 0.07 to 1.73 ± 0.56) and pH values (5.40 ± 0.04 to 5.43 ± 0.08) up to 6 weeks ($P>0.05$). The findings of this study indicate that the formulated semi-moist cat food produced no adverse effects in young adult cats, and further research on pet food formulations for cats using edible waste of seafood processing sector is recommended.

Keywords: Fecal consistency; fish-based cat food; palatability; semi-moist pet food; swordfish



Paper ID: NSALS '26-067 (Poster)

Trust Over Knowledge: Consumer Attitudes and Preferences Driving Antibiotic-free Meat Purchasing Behavior in Galle District

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Antibiotics are widely used in livestock farming to prevent diseases and enhance productivity; however, their misuse and overuse have raised major concerns regarding antimicrobial resistance and the presence of antibiotic residues in food. In Sri Lanka, although regulations exist to control antibiotic use, public understanding and consumer response toward antibiotic-free meat remain insufficiently explored, particularly in the Galle District. This study investigated consumer awareness, attitudes, and preferences related to antibiotic use in meat production and examined their influence on purchasing behavior. A quantitative, cross-sectional survey was conducted among 250 meat consumers across all 22 Divisional Secretariat areas in the Galle District. Data were collected via face-to-face interviews using a structured questionnaire and analyzed using descriptive statistics, correlation, and multiple regression analyses (IBM SPSS, v.27). The respondent group comprised 55.6% females and 44.4% males, with the majority aged 30-49 years and possessing secondary or tertiary education, indicating their active role in household food purchasing. Descriptive analysis indicated that consumer awareness of antibiotic use was relatively low (2.68), while attitudes (3.01) and preferences (2.73) were moderate. Behavioral tendencies were more positive (3.64), reflecting consumers' willingness towards safer purchasing practices. Correlation results demonstrated that consumer behavior correlated more strongly with attitudes ($r=0.603$) than with awareness ($r=0.514$), highlighting that purchasing decisions were shaped more by trust and perception than by knowledge alone. Regression analysis revealed that consumer attitudes ($\beta=0.530$, $P<0.001$) and preferences ($\beta=0.541$, $P<0.001$) were strong positive predictors of purchasing behavior, whereas awareness had a significant but negative influence ($\beta= -0.442$, $P<0.01$). The overall model was significant ($F=57.58$, $P<0.01$) and explained 41.3% of the variance in consumer behavior ($R^2=0.413$). These findings highlight that improving consumer attitudes and strengthening trust in labeling and certification systems are more effective in promoting behavioral change than awareness campaigns alone. The outcomes provide valuable insights for policymakers and industry stakeholders to develop targeted interventions supporting safer, more transparent, and sustainable meat production practices in Sri Lanka.

Keywords: Antibiotic use; antimicrobial resistance; consumer behavior; meat safety; purchasing decision



Paper ID: NSALS '26-157 (Poster)

Knowledge, Attitudes, and Practices Shaping Awareness of Microplastic Contamination in Animal-origin Foods among Sri Lankan Undergraduates

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Microplastic pollution has become a major environmental and food safety concern around the world. Tiny plastic particles less than five mm in size known as microplastics, can enter the human body through animal origin foods such as fish, meat, milk, and eggs. In Sri Lanka, limited data exist on the awareness and behavioral responses toward this issue among young populations in developing countries. Therefore, this study aimed to assess the level of knowledge, attitudes, and practices that affect the awareness of government university students in Sri Lanka, about microplastic contamination in animal origin foods. A cross-sectional survey was conducted among 220 students from 11 government universities representing both science-based and non-science faculties. The sample was balanced with 50% of respondents from science related faculties and 50% from non-science faculties, selected using a judgmental sampling approach to ensure fair representation across diverse academic backgrounds. Data were collected using a structured online questionnaire based on the KAP model and analyzed using Microsoft Excel and SPSS. The reliability of the questionnaire was confirmed (Cronbach's alpha=0.764). Considering the entire student sample most students had heard about microplastics, yet only a limited number had received formal academic exposure to the topic. The regression model was significant ($P<0.001$), explaining a modest proportion of the variation in awareness ($R^2=0.119$). Knowledge had the strongest and most significant effect on awareness ($P<0.001$), whereas attitudes and practices showed weak significant associations. Correlation analysis confirmed positive associations between knowledge, attitudes, and practices with awareness. The findings underscore the importance of integrating microplastic related topics into university curricula and public awareness programs is recommended to strengthen knowledge and foster responsible practices. Enhancing scientific understanding and promoting responsible behavior can contribute to safeguarding food safety, human health, and ecosystem sustainability in Sri Lanka.

Keywords: Animal-origin foods; food safety; microplastics; public awareness; university students



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Paper ID: NSALS '26-026 (Oral)

Microplastic Contamination in Selected Food Fish across Different Trophic Levels in the Negombo Lagoon, Sri Lanka

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Microplastic pollution has been widely recorded in coastal and marine ecosystems. Microplastics present in aquatic environments are frequently ingested by fish species through misidentification as prey, due to their size resemblance to natural prey items. This suggests the potential for microplastic trophic transfer within coastal and marine food webs. However, scientific evidence for such transfer among marine organisms remains limited. Therefore, this study aimed to investigate the relationship between microplastic abundance across different trophic levels and to characterize the extracted microplastics among marine fish species in the Negombo lagoon, Sri Lanka. Seven fish species (*Epinephelus chlorostigma*, *Acanthopagrus butcheri*, *Leiognathus equula*, *Etroplus suratensis*, *Chanos chanos*, *Mugil cephalus*, and *Siganus javus*) representing different trophic levels, were collected from Negombo lagoon. Fish stomachs were selected for microplastic extraction, as stomach contents represent recent microplastic ingestion. Stomachs from fish (n=15 individuals/species) were digested using 10% KOH to extract microplastics. The extracted microplastics were examined under a stereomicroscope to determine their size, shape, and colour, and polymer composition was identified using ATR-FTIR analysis. There was a significant difference in microplastic abundance among fish species in this study (Kruskal–Wallis test, $P < 0.05$). The highest microplastic abundance was recorded in *E. chlorostigma* (4.30 ± 1.06 particles/g wet weight), whereas the lowest was observed in *S. javus* (0.72 ± 0.19 particles/g wet weight). There was a significant positive correlation between microplastic abundance and fish trophic level ($R = 0.89$, $P < 0.05$). The dominant microplastic size, color, and morphotype were small (86%), blue (41%), and fiber (98.04%), respectively, indicating fishing nets as the major source of microplastics in fish stomachs. Low-density polyethylene was the most abundant polymer type (50%), followed by polyethylene terephthalate (20%), polyvinyl acetate (20%), and urea-formaldehyde (10%), suggesting multiple microplastics sources contributing to their accumulation in fish. These findings indicate the potential for trophic transfer of microplastics along fish food chains in the Negombo Lagoon. To our knowledge, this study provides the first evidence of potential microplastic trophic transfer among marine fish species in Sri Lanka, providing baseline information for seafood safety and marine pollution management.

Keywords: ATR-FTIR; blue; fiber; stomach; trophic level



Paper ID: NSALS '26-029 (Oral)

Temporal and Spatial Prevalence of White Spot Syndrome Virus and *Enterocytozoon hepatopenaei* in the Shrimp Industry of Northwestern Sri Lanka: PCR Surveillance, 2021-2024

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White Spot Syndrome Virus (WSSV) and *Enterocytozoon hepatopenaei* (EHP) are significant pathogens that harm shrimp farming in Sri Lanka. This study analyzed monthly Polymerase Chain Reaction (PCR) surveillance data collected by the Coastal Aquaculture Extension and Monitoring Unit of the National Aquaculture Development Authority, Battuluoya from January 2021 to December 2024 to describe spatio-temporal variation of these two pathogens that occurred in the Northwestern region. Monthly and yearly prevalence for each pathogen were calculated, and statistical analysis was done to check for temporal patterns using available data. For each positive sample, the source category (broodstock hatchery, post-larvae (PL) hatchery, or pond) was recorded to examine source-specific spatial trends. Results show clear differences between the two pathogens. WSSV showed low and stable prevalence across months (0-4.85%) and years (1.19-3.21%), with the highest monthly mean observed in December (4.85±6.54%) and no prevalence recorded in April and May. EHP showed larger seasonal peaks and more variation: mean monthly highest peaks occurred in October (15.45±18.79%) and December (11.31±12.20%), and 2022 had a particularly high yearly mean (26.01±10.02%) though that estimate was based on fewer months. Source analysis indicated that WSSV positive samples were mainly pond-derived during the early months (January-March), with increased detections from PL hatcheries in October. EHP positive samples were derived from mixed sources, with broodstock hatcheries contributing predominantly during mid-year (May-July), pond samples dominating toward the end of the year (October-December), and only sporadic detections from PL hatcheries. Hence, we recommend year-round standardized sampling, routine broodstock and PL screening, rapid batch tracing after PL spikes, and strengthened pond biosecurity, especially early in the year, to manage WSSV. Further, targeted pond surveillance and harvest timing during October to December are recommended for better management of EHP. Implementing these actions will help to reduce disease risk and economic losses of the shrimp industry in the Northwestern region of Sri Lanka.

Keywords: Aquaculture; disease management; EHP; PCR; shrimp industry; WSSV



Paper ID: NSALS '26-043 (Oral)

Abundance and Diversity of Whales in Off Mirissa, Southern Coast of Sri Lanka

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Mirissa is a globally renowned whale-watching destination and a significant contributor to Sri Lanka's marine tourism economy. Despite its importance, interannual variations in cetacean abundance and diversity in this region are poorly documented in each year, limiting understanding of temporal changes in species composition and occurrence patterns. This study presents a comparative assessment of cetacean abundance and diversity off Mirissa during the 2024 and 2025 whale-watching seasons to identify temporal changes in sighting frequency, species diversity, and distribution patterns. Whale watching data were collected during March, April, and May of both years using standard whale watching tours. Duration of tour, duration of sighting, and species observed were systematically recorded. In 2024 three tours were conducted, resulting in nine sightings of two cetacean species: Bryde's whale (*Balaenoptera edeni*), accounting for 88.9% of sightings, and blue whale (*Balaenoptera musculus*), accounting for 11.1% of sightings, with an average of three sightings/tour. In 2025, eleven tours resulted in thirty-nine sightings of three cetacean species: fin whale (*Balaenoptera physalus*), Bryde's whale, and blue whale, with fin whales being the most frequently observed species. In addition, a single sighting of a whale shark (*Rhincodon typus*) was recorded, indicating the presence of other marine megafauna in the Mirissa coastal area. When standardized by survey effort, the average number of sightings per tour remained high in 2025, indicating a true increase in cetacean occurrence rather than a sampling effort. Species diversity indices (Shannon Diversity Index= H' and Evenness= J') also increased in 2025 ($H'=0.944$; $J'=0.681$), compared to 2024 ($H'=0.349$; $J'=0.503$), reflecting increased species richness and a more even distribution of sightings among species. Monthly comparisons revealed a marked increase in whale occurrence in March 2025 (24 sightings) compared to March 2024 (3 sightings). These interannual variations may be associated with changes in local hydrodynamic conditions affecting migratory behavior, prey availability, sea surface temperature, and habitat suitability. The findings highlight the dynamic nature of cetacean assemblages in Sri Lankan waters and emphasize the importance of long-term, effort-standardized observation to support sustainable whale watching practices, marine conservation, and ecosystem-based management.

Keywords: Blue whale; Bryde's whale; conservation; Fin whale; marine megafauna; whale-watching industry



Paper ID: NSALS '26-063 (Oral)

Effects of Stocking Density and Nutrient Supplementation on the Growth of *Kappaphycus alvarezii* in Tank Culture

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Kappaphycus alvarezii is one of the red algae, globally known as a major source of carrageenan, which is used for various purposes mainly in food, pharmaceutical, and cosmetic industries. In Sri Lanka, use of seaweed for various applications is gaining popularity as a sustainable livelihood. However, challenges such as reduction of the quality of seaweed during transportation and high cost of transportation, limited knowledge of cultural practices, and lack of tank-based trials restrict its expansion. The present study was conducted to evaluate the effects of stocking density and nutrient supplementation using Albert Solution on the growth of *K. alvarezii* under controlled tank culture conditions. At the initial stage, the effect of different stocking densities on the daily growth rate was experimented with, followed by nutrient supplementation. Experiments were carried out using a completely randomized design with three stocking densities (1 g/L, 3 g/L, 5 g/L) and four concentrations of hydroponic solution (control, 0.1 g/L, 0.2 g/L and 0.3 g/L) with three replicates/treatment. Seedlings collected from Jaffna were acclimatized for one day under optimum conditions and stocked in tanks that contained 5 L of artificial seawater. Water quality parameters (temperature, salinity, pH, Dissolved Oxygen) were monitored, and growth performance was measured weekly over four weeks. Data was analyzed using one-way ANOVA to determine the effect of treatments. Water quality parameters had remained within optimal ranges for *K. alvarezii* culture, with salinity at 30 ppt, temperature at $26.53 \pm 0.88^\circ\text{C}$, Dissolved Oxygen at 5.98 ± 0.11 mg/L, and pH at 8.31 ± 0.07 . In the initial experiment, stocking density (1 g/L, 3 g/L and 5 g/L) showed that there is no significant ($P > 0.05$) effect on daily growth rate. However, different concentrations of hydroponic solutions (0 g/L, 0.1 g/L, 0.2 g/L, and 0.3 g/L) had a significant impact ($P < 0.05$). The control showed growth, while increasing concentrations of hydroponic solution caused a progressive decline in growth, with severe growth inhibition at 0.2 g/L and 0.3 g/L. These findings suggest that *K. alvarezii* performed better without external fertilizer input under the tested conditions. In conclusion, tank culture of *K. alvarezii* is feasible under controlled conditions without nutrient supplementation, while moderate stocking densities (3 g/L) provide stable growth. This study provides baseline insights for future optimization of tank-based seaweed aquaculture in Sri Lanka.

Keywords: Albert solution; *Kappaphycus alvarezii*; seaweed cultivation; stocking density; tank culture



Paper ID: NSALS '26-114 (Oral)

Length-Weight Relationship and Condition Factor of *Oreochromis niloticus* (GIFT Strain): A Case Study from Karagahawewa Reservoir in the Central Province of Sri Lanka

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Karagahawewa reservoir (7° 36' 6" N, 80° 55' 55" E) is a medium-scale reservoir with 150 acres of area in Matale district, Sri Lanka. *Oreochromis niloticus* (GIFT Strain) is one of the major fishery resources in this reservoir. Length-weight relationships (LWRs) are important in understanding the health, growth, habitat, and morphological characterization of fish stocks. However, scientific data on fish length-weight aspects are limited for this reservoir. Accordingly, the main objective of this study was to assess the length-weight relationship and the condition factor of *O. niloticus* (GIFT Strain) stock in this reservoir. *O. niloticus* (GIFT Strain) samples were collected using the gillnets (mesh size: 3-3.5 inches) operated by local fishermen during May to July 2025. In total, 514 fish samples were collected for this study. Males (n=139) and females (n=375) were distinguished using their external morphological characters. Total length and standard length were measured to the nearest 0.1 centimeter scale and weighed using an electronic balance to the nearest gram. Length-weight relationship was calculated using the standard equation: $W=aL^b$ (W=Weight, L=Total length) and the above formula was subjected to logarithmic transformation. Fulton's condition factor (K) and relative condition factor (Kn) were assessed for each fish specimen. Mean total length of the mixed-sex sample, females and males were 20.33±2.39 cm, 19.99±2.19 cm and 21.26±2.66 cm, respectively. Mean weight of above three groups was 186.89±62.24 g, 179.21±57.59 g and 207.46±69.90 g, respectively. In the computed length-weight relationship, growth coefficient (fish relative growth rate, "b") for mixed-sex sample, females and males were 2.77 (R²=0.924), 2.88 (R²=0.922) and 2.61 (R²=0.916), respectively, indicating a negative allometric growth, by increasing body weight at a lower rate than length. The growth coefficient is affected by multiple factors such as water quality parameters, habitat quality, seasonality, food availability, health status, physiological condition, sex, maturity stage and sample size. "K" factor values recorded for mixed-sex sample, females and males were 2.15, 2.17 and 2.09 respectively. "Kn" factor values were 1.00, 0.99, and 1.00 for the mixed-sex sample, females and males, respectively. Condition factor suggests the short-term satisfactory physiological conditions of fish and favorable quality of their habitats during May to July 2025. These findings provide valuable seasonal, baseline information on the length-weight relationship of *O. niloticus* (GIFT Strain), while supporting future studies, fisheries management, stock assessment, and culture-based fisheries in Karagahawewa reservoir.

Keywords: Condition factor; GIFT Tilapia; length-weight relationship; negative allometric growth; reservoir fishery



Paper ID: NSALS '26-122 (Oral)

Cooking and Bio-accessibility Impacts on Chemical Contaminant Concentrations in Seafood: Implications for Seafood Safety Risk Assessment

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Seafood is a vital source of nutrients but can also expose consumers to chemical contaminants. Current seafood safety risk assessments rely on contaminant levels in raw samples from markets or the environment, introducing considerable uncertainty that can lead to over or underestimation of risk. Experimental studies indicate that cooking and contaminant bio-accessibility substantially affect actual contaminant concentrations in seafood at the point of consumption. This study aimed to assess the overall impact of cooking and bio-accessibility on chemical contaminant concentrations in seafood using quantitative data from experimental studies conducted worldwide between 2000 and 2025. It examined inorganic and organic contaminants and biotoxins in fish, mollusks, and crustaceans across six cooking methods (baking, boiling, steaming, frying, grilling, and roasting) and considered bio-accessibility effects. Relevant studies were identified through searches of scientific databases and screened in accordance with the PRISMA protocol, yielding 32 studies for data extraction and quantitative analysis. Based on reported cases, chemical contaminant concentrations in seafood increased in 57%, decreased in 40%, and remained unchanged in 2%. Inorganic contaminants increased to 63%, decreased to 35%, and were unchanged by 2%. Organic contaminants increased to 51%, decreased to 47%, and were unchanged at 1.9%. Biotoxins decreased in 42%, increased in 33%, and remained unchanged in 25%. Across six cooking methods, the reduction in initial chemical contaminant concentration followed the order: grilled (47%) > boiled (28%) > fried (25%) > steamed (24%) > baked (21%) > roasted (10%). Principal component analysis indicated that post-cooking changes in contaminant concentrations are influenced more by the intrinsic chemical properties of the contaminants than by the cooking method itself. One-way ANOVA revealed notable inter-species and inter-chemical variability in bio-accessibility, ranging from 33.9% (Co) to 87.5% (As). Among organic contaminants, values ranged from 26% (PBDEs) to 90.1% (Venlafaxine). Based on the findings, developing a correction factor for seafood safety risk assessments that integrates quantitative changes could be the way forward to minimizing uncertainty in current risk assessment methods.

Keywords: Bioavailability; food safety; heat treatments; heavy metals; human exposure; seafood risk



Paper ID: NSALS '26-129 (Oral)

Impact of the Paalameenmadu Barmouth Opening on Fish Production and Socio-economic Resilience in Batticaloa Lagoon, Sri Lanka

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Batticaloa lagoon is Sri Lanka's third-largest brackish water system, where the periodic opening and closing of its two barmouths at Paalameenmadu and Kallar play an important role in regulating lagoon productivity and fisher livelihoods. The Paalameenmadu barmouth is opened annually through human intervention, whereas the Kallar has remained closed for several years. This study assessed the impact of the Paalameenmadu barmouth operation on fish production, evaluated the socio-economic effects on livelihood during the opening and closing phases, and proposed sustainable management practices. Using stratified random sampling, primary data were collected from 198 active fishers across six lagoon landing sites near Paalameenmadu barmouth from April to July 2025. Secondary data consisted of five years (2020-2024) of monthly fish production and rainfall data obtained from relevant government institutions. Statistical analyses were performed using SPSS version 27.0 to assess the relationship between barmouth activity, fish productivity, daily catch, and fishermen's income. Analyses included Wilcoxon signed-rank tests, paired t-tests, and descriptive statistics to examine the relationships between barmouth activity status, fish catch, rainfall, and income. Results from secondary data showed that annual and monthly fish production was consistently higher during barmouth open periods across all five years, with a marked decline during closed phases. Paired samples t-tests indicated that mean daily fish catch and monthly fisher income were significantly higher during open periods compared to closed periods ($P < 0.05$). In contrast, rainfall showed a weak and non-significant correlation with fish production, highlighting that the barmouth operation status is a stronger driver of fish productivity than rainfall variability. Socio-economic results revealed that 78.8% of respondents earned more than 45,000 LKR per month during the opening period, while income declined substantially during the closed period. Demographically, 58.6% of the respondents were over 50 years of age, indicating a highly experienced yet economically vulnerable fishing community. However, 54.5% demonstrated "good" awareness of the barmouth management. The findings show that timely and well-managed barmouth opening is essential for sustaining lagoon fish production and fisher livelihoods. Based on the observed ecological and socio-economic outcomes, the study recommends a joint management framework involving fisheries authorities, the Irrigation Department, and lagoon fisher societies, supported by systematic hydrological monitoring and targeted community awareness programs to enhance sustainability and socio-economic resilience in Batticaloa Lagoon management.

Keywords: Barmouth; fish production; lagoon; socio-economic; sustainability



Paper ID: NSALS '26-133 (Oral)

Isolation, Identification, and Antibiotic Resistance Assessment of Pathogenic Bacteria from Ulhitiya and Rathkinda Reservoirs in Badulla District, Sri Lanka

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The provision of clean and safe drinking water is a major challenge worldwide, causing millions of cases of illness and death every year, especially in developing countries. Natural water sources, such as reservoirs, often become contaminated with harmful microorganisms due to human activities, which cause serious health problems for people. The present study was aimed to isolate, identify, and evaluate the antibiotic susceptibility of pathogenic bacteria from two freshwater reservoirs; Ulhitiya and Rathkinda located in the Badulla district. Water samples (n=24) were collected from the two reservoirs and water quality parameters including temperature, pH, Dissolved Oxygen (DO), turbidity and electrical conductivity were checked *in situ*. Water samples were cultured on Xylose Lysine Deoxycholate agar. The bacterial isolates were then identified using gram staining, catalase, sulfide-indole-motility and urease tests. To check the antibiotic sensitivity of pathogenic bacteria, E-test method was used for six common antibiotics: amoxicillin, tetracycline, gentamicin, ciprofloxacin, streptomycin, and erythromycin. The pathogenic bacterial isolates were categorized into sensitive, intermediate and resistant according to Clinical and Laboratory Standards Institute guidelines based on E-test minimum inhibitory concentration. The highest mean temperature (31.97±0.22°C), pH (6.29±0.02), turbidity (4.00±0.58 NTU), DO (6.30±0.05 mg/L), and electrical conductivity (128.37±0.53 µS/cm) were recorded in the Rathkinda reservoir compared to the Ulhitiya reservoir. Identified pathogenic bacterial isolates were, *Proteus* spp., *Escherichia coli* and *Shigella* spp. from Ulhitiya and Rathkinda reservoirs. According to E-test results, the Mean Antibiotic Resistance Index (Mean ARI) was calculated for the antibiotics to which they were resistant. *Proteus* spp. isolated from Rathkinda reservoir (Mean ARI=0.67) was resistant to amoxicillin, tetracycline, erythromycin, and streptomycin, *E. coli* (Mean ARI=0.33) isolated from Ulhitiya reservoir was resistant to amoxicillin and erythromycin. *E. coli* (Mean ARI=0.5) isolated from Rathkinda reservoir was resistant to amoxicillin, erythromycin and streptomycin, while *Shigella* spp. isolated from Ulhitiya reservoir (Mean ARI=0.67) was resistant to amoxicillin tetracycline, erythromycin and streptomycin. All isolates were resistant to amoxicillin and erythromycin, while exhibiting sensitivity to gentamicin. The study showed valuable data on antibiotic susceptibility of pathogenic bacteria isolated from reservoirs of Badulla district, highlighting the need for continuous monitoring and effective water management strategies.

Keywords: Antibiotic resistance index; antibiotic susceptibility; E-test method; freshwater reservoirs



Paper ID: NSALS '26-146 (Oral)

The Analysis of Socio-economic Status and Industry Challenges for Sea Cucumber Farmers in Northern Province of Sri Lanka

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Sea cucumber farming is a critical livelihood activity for coastal communities in Northern Province of Sri Lanka. This study aims to assess the socio-economic status of farmers and identifies the main challenges within the industry. Data were collected from 57 farmers across three sites using questionnaires and Key Informant Interviews (KIIs). Quantitative data were analyzed descriptively, and qualitative data thematically. Results show a homogeneous community: most farmers were middle-aged (56% aged 41-60 years), with small households (83% had 0-5 members) and low formal education. For 78%, it was the primary income source while 80% of respondents had over five years of experience. The sector was highly profitable, with an average annual profit of LKR 2.15 million and a 42.6% margin. Major costs were security (~40%) and juvenile acquisition (~35%). The key challenges identified include theft (reported by over 60% of farmers), price volatility, and procedural complexity associated with licensing. KIIs revealed that farming society leaders do not consider the licensing fee to be the principal constraint; rather, they highlighted that the primary burden stems from navigating the complex, multi-departmental licensing procedure. They strongly propose a streamlined, one-window system or a mobile application to expedite renewal. The findings of this study underscore the urgent need for targeted interventions, including formal training programs, enhanced institutional support for security and licensing, and the promotion of processing knowledge to mitigate risks and ensure more sustainable and equitable livelihoods for farmers in Northern Province, Sri Lanka.

Keywords: Coastal fishery; livelihood sustainability; policy challenges; sea cucumber farming; socio-economic status



Paper ID: NSALS '26-149 (Oral)

Assessment of the Effectiveness of Manganese and Iron Removal from Drinking Water using a Biological Trickling Filter System Seeded with *Pseudomonas* and *Bacillus* spp.

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Manganese (Mn) and iron (Fe) contamination at higher concentrations in drinking water can lead to discoloration, undesirable taste and odor, and potential health risks. Long-term consumer exposure to Mn and Fe in drinking water is considered to cause neurological and respiratory effects. The maximum permissible limits of Mn and Fe in drinking water have been defined by Sri Lanka Standards (SLS 614) as 0.1 and 0.3 ppm, respectively. Additionally, Mn levels are required to be reduced to below 0.02 ppm to prevent water discoloration in distribution networks. Biological Trickling Filters (BTF) provide a sustainable alternative for chemical oxidation and filtration to minimize these issues. Hence, this study aimed to evaluate the efficiency of a BTF system seeded with *Pseudomonas* and *Bacillus* spp. affixed to gravel for Mn and also Fe removal in drinking water at bench and pilot scales under continuous and batch modes. The bench-scale setup consisted of nine columns (3 cm diameter × 33 cm height) packed with gravel (porosity≈0.41), tested at combinations of three influent Mn and Fe concentrations (0.5, 1.0 and 1.5 ppm) and three Hydraulic Retention Times (HRTs: 6.3, 9.5 and 19 minutes) in triplicate. Metal ion concentrations in raw and treated water were measured using a DR-6000 UV-Visible spectrophotometer following APHA Standard Methods (3500-Mn, 3500-Fe) with colorimetric minimum detectable limits of 0.006 ppm (Mn) and 0.02 ppm (Fe). Response Surface Method (RSM) was used to test the mean differences and to optimize performance (two-way ANOVA, $P < 0.05$). According to the RSM, the best continuous-mode performance was achieved at a 5 mL/min flow rate with 0.5 ppm influent for Mn, resulting in an effluent of 0.01 ppm (97.9% removal). At the same flow rate with 0.8 ppm influence, Fe recorded an effluent of 0.08 ppm (89.5% removal). In batch mode with 0.5 ppm influence, Mn and Fe achieved effluent concentrations of 0.02 ppm (95.8% removal) and 0.08 ppm (83.3% removal) at HRTs of 13.5 and 18.5 minutes, respectively. Models had high predictive accuracy, with desirability between 0.99 and 1.00. The findings indicate that this BTF system offers a cost-effective, scalable biological treatment method capable of reducing Mn and Fe from influences up to 0.5 ppm and 1.5 ppm respectively, to safe levels in distribution systems under optimized conditions, making it suitable for decentralized treatment in affected areas.

Keywords: Alternative; biological treatment; cost-effective; hydraulic retention time; response surface optimization



Paper ID: NSALS '26-160 (Oral)

Effect of pH on the Growth and Cellulose Yield of *Chlorella vulgaris*

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Chlorella vulgaris is a widely studied microalgae due to its high biomass productivity and diverse biochemical composition, making it suitable for food, aquaculture, cosmetic, and bioresource applications. Although numerous studies have focused on the effect of pH on microalgal growth, limited research has focused on the effect of pH on their cellulose content, which is important for value-added bioproduction such as bioplastics. pH is the key environmental factor that regulates physiological and metabolic activities in microalgae, thereby influencing both biomass accumulation and biochemical composition. The objective of the study was to evaluate the effect of pH on the growth and cellulose yield of *C. vulgaris* under controlled laboratory conditions. Cultivation was carried out in BG11 medium at three pH ranges: acidic (4.5-5.5), neutral (6.5-7.5), and basic (8.0-9.0). Experiments were conducted in triplicate using 1 L culture volumes under continuous illumination and aeration for three weeks. Cell density was monitored every two days using a Sedgwick-Rafter counting chamber. After the cultivation period, biomass was harvested, oven-dried, and quantified, followed by cellulose extraction and conversion to nanocrystals through acid hydrolysis and subsequent quantification. Results are presented as mean±standard deviation. One-way ANOVA revealed a significant effect of pH on both biomass production and cellulose yield ($P<0.05$). Tukey's Honestly Significant Difference (HSD) test indicated that neutral and basic conditions resulted in significantly higher growth and cellulose accumulation compared to acidic conditions ($P<0.05$). No significant difference was observed between neutral and basic treatment ($P>0.05$), indicating comparable performance. The highest biomass yield (10.56 ± 0.3 g) and cellulose content (3.33 ± 0.09 g) were observed under neutral pH conditions, followed by basic pH (9.82 ± 0.05 g biomass and 2.84 ± 0.1 g cellulose). These findings demonstrate that *C. vulgaris* achieves optimal growth and cellulose production under near-neutral pH conditions while maintaining comparable productivity under mild alkaline environments. The study highlights the importance of pH optimization for enhancing cellulose yield and supports the potential integration of *C. vulgaris* cultivation into a wastewater-based system for sustainable resource recovery and circular bio-economy applications.

Keywords: BG11 medium; biomass yield; cellulose production; *Chlorella vulgaris*; pH optimization



Paper ID: NSALS '26-185 (Oral)

Amphibian and Selected Aquatic Associated Species Diversity: A Case Study in Bandiya Dola Ella, Galle, Sri Lanka

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Amphibians are vibrant health indicators in an aquatic environment due to their high sensitivity to changes in their habitat conditions. Recent research trends in Sri Lanka have focused more on amphibian diversity and current records indicate approximately 120 amphibian species, of which 107 (90%) are endemic to the country. This study focused on Bandiya Dola Ella, a relatively pristine tributary of the Gin River located in the Galle district, with the objective of assessing the amphibians and associated faunal diversity within a 2 km stretch of the stream. Data collection was conducted through a visual encounter survey, spending two to three hours in the daytime walking along the stream banks, actively searching for adult frogs and other fauna (prey and predator species of frogs) in the water, on the banks, and in riparian vegetation within 2 m distance from the riverbank along the stream in weekly intervals within a one-month period. Encountered species were captured by a hand net, then identified through a published photographic field guide, counted, and subsequently released back to the same habitat. Relative abundance, species richness (Margalef's Index-Dmg) and the Shannon-Weiner Species Diversity Index (H') were calculated. The survey revealed that 29 individuals belonging to 11 different species, including members of Class Insecta: *Ceylonosticta brincki* (critically endangered damselfly), *Vestails gracilis*, *Stagmatoptera femoralis*, *Ceriagrion tenellum*, Class Reptilia: *Otocryptis wiegmanni*, and *Hypnale* sp. and a freshwater crab sp. Out of the four frog species reported (*Hydrophylax gracilis* and *Indosylvirana serendipi*, *Limnonectes woodworth*, *Duttaphrynus melanostictus*) 2 were endemic (*H. gracilis* and *I. serendipi*) to Sri Lanka and *I. serendipi* was the most abundant frog species reported during the survey. Bandiya Dola Ella stream area exhibited moderately high species richness (Dmg=3.27) and moderate species diversity (H'=2.24). The findings emphasized the ecological significance of the Bandiya Dola Ella area and highlighted its role in conserving Sri Lanka's endemic amphibian fauna.

Keywords: Amphibians; aquatic environment; species diversity; species richness



Paper ID: NSALS '26-191 (Oral)

Phytochemical Composition and Antioxidant Potential of *Aponogeton rigidifolius*, a Critically Endangered Aquatic Plant Endemic to Sri Lanka

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The species of the genus *Aponogeton* show significant medicinal properties, and globally they are traditionally used to treat a wide variety of diseases. *Aponogeton rigidifolius*, a critically endangered aquatic plant endemic to Sri Lanka, is facing a rapid population decline due to anthropogenic influences, including the collection of plants for medicinal purposes in traditional Sri Lankan medicine. However, scientific knowledge on the phytochemical and antioxidant properties of this endemic species remains limited, restricting the development of evidence-based conservation strategies and conservation-oriented sustainable utilization approaches. This study aimed to evaluate the biochemical composition and antioxidant potential of *A. rigidifolius*. Mature, healthy leaves were collected from natural populations, washed, shade-dried, powdered, and analyzed in triplicate. Proximate composition was determined on a dry weight basis following standard AOAC (2019) procedures. Phytochemicals extracted using absolute ethanol (24 hours at room temperature), hot (80°C for 2 hours), and cold (24 hours at room temperature) aqueous extraction methods were screened for secondary metabolites, antioxidant potential, and total phenolic compounds using the Folin-Ciocalteu method. Proximate analysis revealed a dry matter content of 87.23±0.41% and a corresponding moisture content of 12.77±0.41%. On a dry weight basis, the dry matter comprised ash (14.47±0.52%), crude protein (18.49±0.63%), crude fiber (30.20±0.34%), and crude fat (0.78±0.12%). Basic phytochemical screening confirmed the strong presence of alkaloids, flavonoids, phenolics, tannins, terpenoids, steroids, and quinones in ethanolic extracts compared with cold and hot aqueous extracts, while saponins were absent in all studied extracts. The DPPH radical scavenging activity assay revealed antioxidant values of 65.04±1.23%, 63.56±0.42%, and 43.8±2.16% for cold aqueous, ethanolic, and hot aqueous extracts, respectively, indicating that the cold aqueous extract exhibited the highest antioxidant activity. Ethanolic extract showed significantly higher total phenolic content (642.60±54.83 mg GAE/gm) compared to cold (186.67±37.50 mg GAE/gm) and hot (290.37±52.78 mg GAE/gm) aqueous extracts ($P<0.05$). These results suggest that ethanol as a solvent extracts many phytochemicals with higher total phenols than the cold and aqueous solvents. The presence of bioactive metabolites supports the potential for carefully regulated, non-destructive bioprospecting approaches, which may provide scientific support for conservation initiatives.

Keywords: Bioprospecting; DPPH assay; ethanolic extract; proximate analysis; secondary metabolites; total phenolic content



Paper ID: NSALS '26-197 (Oral)

Isolation and Identification of Pathogenic Bacteria Associated with Mangrove Sediments of Rekawa Lagoon, Sri Lanka

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Mangroves are dynamic wetland ecosystems characterized by salt-tolerant shrubs and trees that thrive where freshwater meets seawater. The microbes associated with mangroves play a crucial role in the ecosystem. Nevertheless, sediments in mangrove environments may serve as reservoirs for pathogenic bacteria, creating potential threats to aquatic life and human health. The present study aimed to isolation and identification of pathogenic bacteria connected to the microbiome in Rekawa Lagoon, Sri Lanka. Sediment samples were collected in triplicate at a depth of 5 cm from nine locations. The sediment samples were brought to the laboratory and the replicates were pooled. The pooled sediment samples were suspended in sterilized distilled water and processed using the standard dilution plating method. Serial dilutions (10^{-1} , 10^{-2} , 10^{-3} , and 10^{-4}) were prepared, and the samples were cultured on Xylose Lysine Deoxycholate (XLD) agar. The cultured plates were incubated at 28°C for 24 hours, and selected colonies were further purified by subculturing on XLD medium as a routine procedure. The isolates were identified using a series of biochemical assays, including Gram staining, oxidase, urease, and sulphide indole motility tests. The E-test method was employed to evaluate the susceptibility of the bacterial isolates to two antibiotics, namely amoxicillin and tetracycline. Based on the findings from the E-test, the Mean Antibiotic Resistance Index (Mean ARI) was calculated for the antibiotics to which the isolates showed resistance. The results indicated that the isolates were *Shigella* spp. and *Escherichia coli*. According to the E-test Minimum Inhibitory Concentration (MIC) values, interpreted in accordance with Clinical and Laboratory Standards Institute guidelines, both *Shigella* spp. and *E. coli* were found to be resistant to amoxicillin and tetracycline (MIC >256 µg/mL). Both *Shigella* spp. and *E. coli* (Mean ARI=1) exhibited resistance to amoxicillin and tetracycline, signifying a high level of antibiotic resistance. These findings highlight the presence of antibiotic-resistant pathogenic bacteria in the mangrove sediments of Rekawa Lagoon, which raise considerable environmental and public health concerns. It is crucial to implement continuous monitoring and management strategies that are essential to control the spread of antibiotic resistance in these ecologically important ecosystems.

Keywords: Amoxicillin; antibiotics; *Escherichia coli*; *Shigella* spp.; tetracycline.



Paper ID: NSALS '26-198 (Oral)

Isolation and Identification of Pathogenic Bacteria Associated with Kalpitiya and Ettalai Seagrass Meadows of the Puttalam Lagoon, Sri Lanka

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Seagrass meadows are one of the most important marine ecosystems that provide important ecological functions, including carbon sequestration, nutrient cycling, and habitat for diverse marine species. Despite their productivity, these ecosystems are increasingly threatened by anthropogenic pollution, which can foster the proliferation of pathogenic bacteria with implications for both marine life and human health. The limited research has examined the role of seagrass meadows as reservoirs of pathogenic bacteria, making this study a novel contribution to understanding the intersection between ecosystem health and microbial risks. Therefore, the present study focused on the isolation and identification of pathogenic bacteria associated with seagrass beds in the Kalpitiya and Ettalai regions of Sri Lanka, with the aim of assessing the antibiotic susceptibility of these bacterial isolates. Water samples (n=18) were collected from three randomly selected points within each seagrass meadow site using sterile bottles. Samples from each site were pooled and were cultured on Citrate, MacConkey and Xylose Lysine Deoxycholate agar for the isolation of pathogenic bacteria. Bacterial isolates were identified through biochemical tests, including Gram staining, catalase, urease, and sulfide-indole-motility tests. Antibiotic susceptibility tests were performed using the E-test method (minimum inhibitory concentration values) against two common antibiotics: amoxicillin and erythromycin. The isolated pathogenic bacteria were categorized into sensitive, intermediate, and resistant, according to the Clinical and Laboratory Standards Institute guidelines. The Mean Antibiotic Resistance Index (Mean ARI) was calculated for the antibiotics to which they were resistant. The bacterial isolates were identified as *Salmonella* sp. and *Shigella* sp. in Ettalai, while *Escherichia coli* and *Shigella* sp. in Kalpitiya seagrass meadows. The isolates of *Salmonella* sp. (Mean ARI=1) in Ettalai and *Shigella* sp. (Mean ARI=1) in Kalpitiya were resistant to amoxicillin and erythromycin, while *Shigella* sp. in Ettalai and *E. coli* in Kalpitiya showed intermediate resistance to amoxicillin. This study provides novel insights into antibiotic-resistant pathogenic bacteria in seagrass ecosystems of Sri Lanka, highlighting potential public health risks linked to coastal pollution. Future research should focus on assessing anthropogenic and environmental influences by applying molecular tools for precise species-level identification and resistance characterization, making continuous monitoring essential to track emerging threats.

Keywords: Antibiotics; antibiotic susceptibility; antimicrobial resistance; coastal pollution; water quality assessment



Paper ID: NSALS '26-205 (Oral)

Exploring Waste of Fish Processing Facility as Substrates for Black Soldier Fly (*Hermetia illucens*) Larvae Rearing and their Nutrient Composition as a Replacement for Fish Meal in Aquaculture Feed

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Improper disposal of fish processing waste is one of the serious environmental issues and underscores the need for sustainable utilization strategies. Further, production of high-quality aquaculture feed remains critically dependent on quality fish meals. This study explores the suitability of fish-processing waste and kitchen waste as a substrate for rearing black soldier fly larvae (BSFL) and examines the nutrient composition of the resulting larvae for possible substitution of fish meal in aquaculture feed. Three waste substrates generated from a single processing facility: fish processing waste (FPW), shrimp-head waste (SHW) and kitchen waste (KW) were separately used, fish waste and shrimp waste were mixed with rice bran to regulate moisture content about 50%. The conversion efficiencies and larval protein contents were determined. The results indicated that 10.5 kg of both FPW and SHW and 12.6 kg of KW were required to produce 1 kg of fresh larvae (wet weight). Moreover, it was found that to yield 1 kg of dried insect meal 3.2±0.15 kg, 2.9±0.10 kg and 2.85±0.20 kg of wet weight larvae produced from FPW, SHW and KW, respectively were required. The crude protein content of larvae fed on FPW was 49.3%, on SHW 46.0% and on KW 38.3% (Kjeldahl method). These findings demonstrate that BSFL can effectively convert fish and shrimp derived processing wastes into high-protein biomass, with the FPW substrate achieving the most efficient conversion and highest protein yield. Kitchen waste, while still usable, resulted in lower conversion efficiency and larval protein content. The study underscores the potential of integrating BSFL production into fish processing waste management schemes and the formulation of insect meal as an alternative protein source for aquaculture feed. Further studies on amino acid profiles, digestibility, growth performance of target aquaculture species, and economic assessment are recommended to evaluate the substitution of fish meal with BSFL meal in commercial feeds.

Keywords: Alternative aquaculture feeds; black soldier fly larvae; fish feed; fish meal; shrimp head waste



Paper ID: NSALS '26-218 (Oral)

Differentiating Morphologically Similar Aquatic Plant Species (*Ludwigia repens* and *Ludwigia palustris*) using Quantitative Metrics

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Identifying aquatic plant species at their earliest developmental stage is a critical yet challenging task for regulatory compliance in the global trade of aquatic plants. This difficulty arises because most flowering aquatic plant species cannot be distinguished accurately until the flowering stage. The substantial morphological resemblance between selected species, *Ludwigia repens* and *Ludwigia palustris*, at their early growth stages exemplifies this challenge and prevents reliable identification. Therefore, this study aimed to identify and validate specific morphological characteristics that uniquely distinguish these two aquatic plant species during their early developmental stages, enabling precise identification. Experimental plants were established using top cuttings under pot culture conditions. The culture medium consisted of 40% topsoil, 30% compost, and 30% river sand. Plants were maintained in a protected house with 50% shade netting at a temperature range of 25-28°C. After five weeks of growth, seven morphometric traits (leaf length, leaf width, leaf area, leaf perimeter, leaf tip angle, length-to-width ratio, and inter-vein space) were quantitatively measured from 60 plant samples (30/species) using ImageJ software (version 1.54i). One-way ANOVA was performed using Minitab 19 to determine statistically significant interspecific differences. Results indicated that six traits differed significantly between species ($P < 0.05$). Leaf length was the most effective discriminating parameter, with *L. palustris* exhibiting significantly longer leaves (3.14 ± 0.35 cm) compared to *L. repens* (2.08 ± 0.21 cm). In addition, the length-to-width ratio and leaf tip angle differed significantly between species. The lack of significance in leaf width indicates that size-based parameters alone are insufficient for differentiation, highlighting the importance of shape-based indices. *L. palustris* is characterized by long, narrow leaves with pointed tips (76.21°), whereas *L. repens* exhibits broader, oval leaves with rounded tips (112.76°). This study provides a definitive, quantitative key for differentiating *L. repens* and *L. palustris* at early growth stages. To the best of current knowledge, no prior study has reported a species-specific quantitative key for early-stage identification of these two morphologically similar aquatic plant species. Therefore, this study establishes a reliable, data-driven method for species authentication.

Keywords: Leaf morphology; *Ludwigia palustris*; *Ludwigia repens*; morphological analysis; quantitative traits; species authentication



Paper ID: NSALS '26-225 (Oral)

Preliminary Assessment of Bacterial Abundance and Water Quality in Tube Wells of Badulla and Trincomalee Districts in Sri Lanka

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Access to safe drinking water is a global public health priority. In Sri Lanka, tube well water is a primary source of drinking water, necessitating ongoing monitoring to ensure its safety. This study aimed to explore the influence of water quality parameters on bacterial abundance in tube wells located in the climatically distinct districts of Badulla and Trincomalee. Water samples (n=30) were collected in triplicate from five wells within each district. The tube wells were selected based on accessibility and community usage within each district. Temperature, pH, salinity, and electrical conductivity were measured *in-situ*. Bacterial abundance was determined by using a standard dilution plating method with serial dilutions (10^{-1} , 10^{-2} , and 10^{-3}) of samples plated on Reasoner's 2A agar, each with replicates, followed by aerobic incubation at room temperature. Colonies were enumerated after 24 h and 48 h of incubation, and the results were expressed as colony-forming units per milliliter (CFU/mL). The results exhibited that the highest mean temperature ($30.56 \pm 0.78^{\circ}\text{C}$) was observed in tube well water from Trincomalee, whereas the highest mean pH (7.37 ± 0.72) was recorded in the tube well waters from Badulla. Colony counts showed no significant differences ($P > 0.05$) between the two districts at 24 h and 48 h. The findings suggest that variations in physicochemical parameters in water may not significantly impact the bacterial loads found in tube wells within the examined conditions. However, the detection of culturable bacteria highlights the importance of ongoing monitoring and more comprehensive studies that include additional microbial and chemical factors. It is crucial to broaden the focus of future research with larger sample sizes, seasonal observations, and analyses specific to pathogens to gain a better understanding of risks and to guide strategies aimed at protecting community health.

Keywords: Bacterial load; CFU; colonies enumeration; physicochemical parameters; public health; water safety



Paper ID: NSALS '26-143 (Poster)

Fishery and Socioeconomic Status of Myliddy, Myliddithurai and Thyiddy Fishing Villages in Northern Sri Lanka

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The fishing communities of Myliddy, Myliddithurai, and Thyiddy in the Jaffna Peninsula are essential to the regional economy, however, the socioeconomic and fishery status of these three fishing communities remains under documented, as information on these villages is limited in the existing literature. This study provides a systematic assessment of the socioeconomic conditions and the status of fisheries in these villages to improve sustainable management. The study was conducted from March 2025 to July 2025. Data were collected from 92 stakeholders, including fishermen, traders, dry fish producers, and fishing laborers selected through simple random sampling from a total population of 119 stakeholders, using a pretested structured questionnaire, interviews, interactive group discussion, and direct field observation. The data collected were analyzed using IBM SPSS 27 and Microsoft Excel. The study showed a male-dominated community (77.17%), characterized by 63.04% of stakeholders above 50 years of age and 4.35% youth representation. The predominance of primary-level education among respondents limited their capacity to adopt modern practices. With 89.36% ownership of boats being high, income was uneven, with most fishers (35) earning Rs. 80,000-160,000 annually. The fishery is characterized by low technological diversification, dominated by outboard fiber-reinforced boats and drift gill nets (87.8%), and identified by long working hours (15-20 hrs). The catch composition was dominated by the high-value pelagic species, primarily of the Scombridae family (40%), followed by the Carangidae family (29%). Analysis of the three-year fisheries production trend (2022-2024) indicates the highest production in 2022, with an output of approximately 200 tons, while production declined in 2023 and 2024. Importantly, the results of the one-way ANOVA indicated that fishing method had a statistically significant effect on average daily catch ($F=13.33$, $P<0.001$), demonstrating significant differences in catch productivity among the fishing methods used. The study highlights the importance of understanding local fishing practices and socio-economic status to develop fisheries management in the region that enhances sustainability, livelihood resilience, and resource conservation.

Keywords: Catch data; CPUE; fish production; fishery status; socio-economic; sustainability



Paper ID: NSALS '26-222 (Poster)

Antimicrobial Potential of Biosurfactant Produced by Thermophilic Bacteria Isolated from Maha Oya Hot Water Spring in Sri Lanka

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Hot water springs are unique geothermal ecosystems that harbor diverse microorganisms adapted to elevated temperatures. They are capable of producing valuable biosurfactant compounds with pharmaceutical and industrial importance. These compounds could provide alternative solutions to the growing problem of antimicrobial resistance caused by the overuse of antibiotics in humans and animals worldwide. This study aimed to evaluate the antimicrobial potential of biosurfactant produced by a thermophilic bacterium isolated from the Maha Oya hot water spring in Sri Lanka against *Escherichia coli* and *Shigella* spp. Water samples (n=9) were collected from the Maha Oya hot water spring and cultured on Brain Heart Infusion (BHI) agar. The isolate was purified by subculturing, and biochemical tests were performed for preliminary identification. Molecular identification of the isolate was confirmed using 16S rRNA gene sequencing. Biosurfactant production was initially assessed using oil displacement, emulsification index, and drop collapse assays. Crude biosurfactant was extracted using the ethyl acetate method. Antimicrobial activity was assessed using the disc diffusion method with crude biosurfactant at 100%, 75%, 50%, and 25% (v/v) concentrations, prepared by dilution with sterile distilled water. The isolate was identified as *Streptomyces thermocarboxydus*. At 100% concentration, the biosurfactant exhibited the strongest antimicrobial activity, with inhibition zones of 2.48 ± 0.04 cm against *E. coli* and 1.70 ± 0.18 cm against *Shigella* spp. At 75% concentration, inhibition zones of 1.65 ± 0.08 cm (*E. coli*) and 1.46 ± 0.29 cm (*Shigella* spp.) were observed. At 50% concentration, reduced activity was recorded (0.84 ± 0.06 cm against *E. coli* and 0.72 ± 0.03 cm against *Shigella* spp.), while no inhibition was observed at 25% concentration. These findings highlight the significant biosurfactant-associated antimicrobial potential of thermophilic bacteria. It emphasizes the untapped biotechnological value of Sri Lankan hot water springs as reservoirs of bioactive, metabolite-producing microorganisms. These metabolites are valuable in combating antimicrobial resistance and hold significant potential for biotechnological applications.

Keywords: Bioactive metabolites; disc diffusion method; ethyl acetate extraction; pathogenic bacteria



CROP PRODUCTION TECHNOLOGY

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Paper ID: NSALS '26-009 (Oral)

Evaluation of Growing Conditions to Improve the Growth and Yield Performance of Horse Gram (*Macrotyloma uniflorum*) Microgreens

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Microgreens are young greens grown from vegetable seeds, usually harvested 7-14 days after germination, with high nutritional content, including vitamins, minerals, and antioxidants. Evaluation of growing conditions is a key step toward maximizing growth and yield under sustainable and economical production systems. They are widely popular worldwide, but their production, consumption, and awareness in Sri Lanka remain limited, primarily restricted to high-end hotels and restaurants. This study aimed to evaluate the growing conditions for horse gram (*Macrotyloma uniflorum*) microgreens, with a focus on sowing density, growing media, and harvesting stages. The research was conducted in a completely randomized design with three replications as three separate experiments. In the first experiment, three seed densities (1, 2, and 3 seeds/cm²) were tested. In the second experiment, four growing media were evaluated: (M1: compost+coir dust 1:1 v/v, M2: compost+paddy husk charcoal 1:1 v/v, M3: tissue paper with 50 ppm Albert solution, and M4: plain tissue paper). In the third experiment, three harvesting stages (5, 7, and 10 days after sowing) were tested. Results showed that 3 seeds/cm² produced the highest biomass (fresh weight: 62.49±7.95 g; dry weight: 5.89±0.52 g; $P<0.05$). However, based on growth performance, crop coverage, canopy uniformity, and economic considerations, the optimal sowing density was identified as 2 seeds/cm². Compost and coir dust (M1) was identified as the most effective growing medium, producing the tallest shoots (7.73±0.28 cm; $P<0.05$) and the highest fresh weight (46.63±3.27 g; $P<0.05$). Considering yield performance (fresh weight: 46.41±3.13 g; dry weight: 5.14±0.24 g; $P<0.05$) and sensory attributes, harvesting horse gram microgreens at 7-10 days after sowing was identified as the most suitable stage. In conclusion, the combination of 2 seeds/cm² sowing density, compost-coir dust medium, and harvesting at 7-10 days after sowing offers a practical and sustainable approach to maximizing horse gram microgreen production in Sri Lanka.

Keywords: Growing media; harvesting stage; horse gram; microgreens; sowing density



Paper ID: NSALS '26-018 (Oral)

Potential of *Acorus calamus* and *Justicia adhatoda* in Protecting Stored Paddy Grains against *Sitotroga cerealella* (Lepidoptera: Gelechiidae)

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Rice (*Oryza sativa* L.) is a staple food crop of global importance, providing nutrition to more than half of the world's population. Several insect pests cause post-harvest losses of paddy during storage, including the rice weevil (*Sitophilus oryzae*), lesser grain borer (*Rhyzopertha dominica*), and red flour beetle (*Tribolium castaneum*). Among these, the rice grain moth, *Sitotroga cerealella* (Lepidoptera: Gelechiidae), is one of the most serious pests infesting stored rice grains, causing losses in both grain quantity and quality. Overreliance on synthetic insecticides has led to resistant insect populations, pest resurgence, and harmful residues, highlighting the need for eco-friendly alternatives. This study evaluated the potential of *Acorus calamus* rhizome and *Justicia adhatoda* leaf products in protecting stored paddy, using three types of botanical treatments: aqueous extract, flavonoid extract, and powdered material. Plant powders were prepared by shade-drying and sieving, flavonoid extracts were obtained by macerating powdered material in 80% aqueous methanol for three days, and aqueous extracts were prepared using Soxhlet extraction with distilled water for 36 hrs at room temperature (30±2°C). Treatments were applied at 5 g/500 g for powders, 5 mg/500 g for flavonoid extracts, and 5 mL/500 g for aqueous extracts. Grains were thoroughly mixed to ensure uniform coating, and three pairs of newly emerged *S. cerealella* adults were introduced under laboratory conditions (30±2°C, 70±5% RH). The experiment followed a completely randomized design with seven treatments, including an untreated control, and four replicates per treatment. Data on adult mortality, F1 progeny reduction, and grain damage were subjected to analysis of variance after arcsine square root transformation. Mean comparisons were performed using Tukey's HSD test at $P < 0.05$ using Minitab v.22. Results showed significant differences among treatments. *A. calamus* rhizome powder caused 100% adult mortality within 24 hrs, completely inhibited F1 progeny emergence, and prevented grain damage. The aqueous extract of *A. calamus* also showed high efficacy, while *A. calamus* flavonoid extract and *J. adhatoda* products had moderate activity. Variation among treatments reflects differences in bioactive compound potency. These findings indicate that selected plant-derived formulations, particularly *A. calamus* rhizome powder, can serve as effective, eco-friendly alternatives to synthetic insecticides, providing a sustainable approach to protecting stored paddy against *S. cerealella*.

Keywords: Bioactive compounds; botanical treatments; post-harvest losses; synthetic insecticides



Paper ID: NSALS '26-022 (Oral)

Effect of Different Mulches on Surface Runoff, Soil Erosion, and Weed Suppression in Newly Planted Tea Land

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Surface runoff, soil erosion, and weed occurrence are severe issues found in newly planted tea lands until the tea canopy fully covers the soil surface. Mulching is a recommended practice to overcome these issues, which enhances the establishment of tea. Different mulching materials are used in tea cultivation, but their potential in reducing surface runoff, soil erosion, and weed biomass has not been quantified. Therefore, this study was conducted at the Waltrim Estate, Talawakelle. The slope of the site ranged from 45-60%. The average soil bulk density was 1.18 g/cm³, due to the field just after planting. The experiment was laid out in a randomized complete block design with three replications. The treatments consisted of mana grass, coconut fiber, black polythene, and agricultural mulch, along with the untreated control. The cumulative runoff and soil loss were calculated under 345.8 mm of cumulative rainfall. The dry weed biomass was calculated eight weeks after mulching. Coconut fiber and mana grass significantly reduced runoff by 88 and 87%, respectively, while agricultural mulch and black polythene significantly increased runoff by more than eight times, compared to the control (49,936 L/ha, $P < 0.05$). Coconut fiber and mana grass showed superior runoff control by facilitating infiltration, but agricultural mulch and black polythene showed poor runoff control due to their impermeable nature. Coconut fiber, mana grass, black polythene, and agricultural mulch significantly reduced soil loss by 100, 100, 87, and 84%, respectively, compared to the control (220.9 kg/ha, $P < 0.05$). Agricultural mulch, black polythene, and mana grass significantly reduced weed biomass by 93, 81, and 64%, respectively, while coconut fiber reduced weed biomass only by 24%, compared to the control (117.29 kg/ha, $P < 0.05$). Coconut fiber and mana grass are best suited for sloping lands, as they effectively minimize runoff and soil erosion. Agricultural mulch and black polythene are best for tea lands, where weed management is critical, but more attention should be given to water management when they are used in sloping lands. Therefore, the most appropriate mulching materials should be selected based on management objectives, material availability, and the cost of mulching.

Keywords: Mulching; surface runoff; soil erosion; tea land; weed management



Paper ID: NSALS '26-024 (Oral)

Effectiveness of Tea Yara Fertilizer Complex on the Yield Performance of Mature Tea (*Camellia sinensis*) in Kendagolla, Uva Region

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Declining yield in tea (*Camellia sinensis*) plantations of the Uva region is attributed to soil nutrient depletion and the limited effectiveness of currently used fertilizer mixtures. Tea Yara based fertilizer mixtures, recommended from up-country and low-country trials by the Tea Research Institute of Sri Lanka, have not yet been scientifically tested in the Uva region. This study evaluated the effectiveness of Tea Yara based mixtures on yield, nutrient status, and cost effectiveness of mature tea under Uva mid-country conditions. The trial was conducted in Kendagolla, Badulla district, located at 1,030 m above sea level, on red yellow podzolic soils. Four fertilizer treatments were evaluated: T1 - U709 (28:4:14) at 309 kg/ha (control); T2 - Super Tea (27:5:13) at 272 kg/ha; T3 - U709 at 247 kg/ha combined with Tea Yara (23:7:10) at 25 kg/ha; and T4 - U709 at 185 kg/ha combined with Tea Yara at 62 kg/ha. Treatments were applied on 3 May 2025; previously, only U709 was used. The experiment was a randomized complete block design with three replicates. Parameters evaluated included soil pH, available nitrogen (N), available phosphorus (P), and exchangeable potassium (K), leaf N, P, and K, leaf chlorophyll content (SPAD values), shoot composition, yield, and cost-effectiveness. Data were subjected to ANOVA, and the treatment means were compared using Tukey's HSD test ($P < 0.05$). Results showed no significant differences among treatments for soil parameters, leaf P, leaf K, or SPAD. Significant ($P < 0.05$) differences were observed in total yield, leaf N, shoot composition, and cost-effectiveness. T4 recorded the highest yield, 43.5% greater than T1, and leaf N concentration 165.1% higher than T1. This improvement is linked to N form, as U709 supplies only ammonium, whereas Tea Yara provides both ammonium and nitrate, which can enhance uptake efficiency. T4 had more pluckable arimbu shoots, with fewer banji shoots than T1. T4 was the most profitable, with the lowest fertilizer cost per kg yield. Overall, T4 was the best performing treatment, showing the most favorable balance between yield, nutrient status, and economic efficiency under Uva mid-country conditions.

Keywords: *Camellia sinensis*; fertilizer mixtures; Tea Yara; U709; Uva region; yield performance



Paper ID: NSALS '26-041 (Oral)

Comparative Evaluation of Nursery Performance of Tea Cultivar, TRI 3072 under Conventional and Rice Husk Charcoal-based Potting Medium

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Tea (*Camellia sinensis* (L.) O. Kuntze) nursery plants require suitable growing media to ensure healthy growth and successful field establishment. Due to declining availability, variability in physical structure, poor aeration, compaction and potential contamination with soil-borne pathogens, Rice Husk Charcoal (RHC), an abundant agro-waste material is proposed as a sustainable alternative component of potting media. The study was conducted using a completely randomized design with 100 healthy tea cuttings planted for each medium. This study evaluated the growth performance of TRI 3072 tea cuttings in four media: 100% soil (control), 75% soil+25% RHC, 50% soil+50% RHC, and 25% soil+75% RHC. Growth parameters; leaf count, leaf area, shoot height, root length, and biomass were recorded at 8, 10, and 13 weeks after planting. Physical and chemical properties of media were also assessed. Data were analyzed using One-way ANOVA and means compared by Tukey's test at $P < 0.05$. The results showed no significant differences ($P > 0.05$) in early leaf count among treatments. Leaf area was highest in 100% soil at 8 weeks (17.21443 cm²), but 25% soil + 75% RHC surpassed all others at 10 weeks ($P < 0.05$), indicating RHC benefits for water retention and aeration. The distance from the apical bud to the mother leaf (shoot height) was not significant early on, but 50% soil + 50% RHC showed reduced distance at 13 weeks (1.2042 cm). Root length was significantly greater in RHC-based media at 10 weeks ($P < 0.05$). Media with higher RHC had increased water holding capacity and decreased bulk density but elevated pH and electrical conductivity. The 75% soil + 25% RHC combination offered physical and chemical properties closest to control and maintained comparable plant growth. This study demonstrates that RHC-amended media as a viable alternative for tea nurseries, with 75% soil + 25% RHC mixture identified as the most suitable formulation for early-stage nursery growth. Further long-term research is recommended to assess performance during subsequent developmental stages and field establishment.

Keywords: Growing media; leaf area; nursery media; sustainable agriculture; tea nursery



Paper ID: NSALS '26-073 (Oral)

Physiological and Biochemical Responses of Tea (*Camellia sinensis* (L.) O. Kuntze) to Waterlogging Stress

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Waterlogging stress restricts plant growth, development, and yield by altering key physiological and biochemical processes, such as photosynthesis, root respiration, nutrient uptake, and antioxidant metabolism. In Sri Lanka, tea smallholdings in low-lying areas are especially vulnerable to waterlogging stress. Despite increasing waterlogging under climate change, the physiological and biochemical bases of tolerance in tea remain poorly understood. Therefore, this study was conducted to evaluate the changes in physiological parameters (photosynthesis rate, leaf transpiration rate, leaf temperature, stomatal conductance, and relative water content) and biochemical parameters (leaf chlorophyll content, leaf total soluble sugar content) under waterlogging conditions in the TRI 2023 and TRI 2025 cultivars, which were commonly grown in different climatic regions in Sri Lanka. The experiment was conducted under a rain shelter at the Tea Research Institute, Talawakelle, to control natural rainfall and ensure uniform conditions. A two-factor completely randomized design was employed with 12 replicates, where the experimental factors were cultivar and water management condition. These two cultivars were evaluated by inducing artificial waterlogging for a period of 40 days compared with the normal conditions. Photosynthesis rate, stomatal conductance, leaf temperature, and leaf transpiration rates were measured on days 10, 20, 30, and 40 after treatment imposition, while relative water content, leaf chlorophyll content, and total soluble sugar content were measured on day 40. Data were analyzed by General Linear Model. Under waterlogging conditions, photosynthesis, stomatal conductance, transpiration, and chlorophyll content decreased in both cultivars. Forty days after waterlogging, TRI 2025 showed significantly ($P < 0.05$) greater reductions in photosynthesis (87%), stomatal conductance (88%), and transpiration compared with the control, whereas TRI 2023 exhibited comparatively lower reductions of 82%, 85%, and 80%, respectively, indicating greater waterlogging tolerance in TRI 2023. The mean total soluble sugar content increased by 35% in the TRI 2023 cultivar and by 26% in TRI 2025, with TRI 2023 accumulating higher soluble sugar levels than TRI 2025 after 40 days of waterlogging. Overall, TRI 2023 demonstrated comparatively better physiological stability and biochemical adjustment under waterlogging stress, indicating that TRI 2023 is a more suitable cultivar for cultivation in waterlogging-prone environments. Both cultivars under waterlogging conditions showed lower root length compared to the normal condition. Thus, selected physiological and biochemical parameters serve as effective indicators for identifying waterlogging-tolerant cultivars.

Keywords: Chlorophyll; photosynthesis; stomatal conductance; transpiration; waterlogging



Paper ID: NSALS '26-087 (Oral)

Evaluation of the Optimum Growth Stage for Propagation of Potato (*Solanum tuberosum* L.) by Apical Rooted Cuttings under Protected Cultivation Conditions

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Potato (*Solanum tuberosum* L.) is a globally important food crop, and efficient propagation methods are essential for the production of healthy and uniform planting material. Apical rooted cuttings (ARC) offer a potential alternative to conventional propagation, enabling rapid and disease-free multiplication. In Sri Lanka, commercial potato cultivation relies on imported seeds and high technology systems like aeroponics and hydroponics, hence identifying an efficient, affordable propagation technique like ARC is essential to reduce cost of production and promote sustainable farming. This study evaluated the ARC technique to identify the optimum cutting age for yield maximization under protected cultivation conditions at the Agricultural Research Station, Seetha Eliya. The experiment was conducted using the Granola variety in a randomized complete block design (blocking factor-light), consisting of four treatments (T1: 21-day-old ARC, T2: 18-day-old ARC, T3: 15-day-old ARC, and T4: 7-day-old ARC) and three replications. Growth parameters (leaf number, plant height, branch number, and survival rate) were assessed over nine weeks, and yield parameters (tuber number and fresh weight) were assessed at harvest (week 9). Age of cuttings significantly ($P < 0.05$) influenced early growth stages. Older cuttings (T1: 21 days and T2: 18 days) exhibited greater plant height and branching at the initial stages, likely due to more developed root systems and higher resource reserves that supported vigorous canopy development. Although younger cuttings (T4: 7 days) produced a higher number of leaves initially, the older ARCs maintained superior overall vegetative growth. From the fourth week onward, differences among treatments for growth parameters were not significant ($P > 0.05$), and by the ninth week, all treatments exhibited comparable plant height, branching, and leaf numbers. Survival rates were high ($> 85\%$) and uniform across treatments, with no significant differences. Yield results indicated that 21-day-old ARCs achieved the highest fresh tuber weight (1.6 ± 0.35 kg/plant), while 15-day-old ARCs produced the greatest number of medium-sized tubers (> 70 tubers/plant). No significant treatment or block effects ($P > 0.05$) were detected for overall yield. These findings suggest that ARCs aged between 14 and 21 days provide balanced growth between vegetative and tuber growth while producing marketable seed potatoes.

Keywords: Apical rooted cuttings; net house conditions; potato propagation; seed potatoes; vegetative growth; yield parameters



Paper ID: NSALS '26-094 (Oral)

Evaluation of Chlorine as a Sterilizer of Soil-based Tomato (*Solanum lycopersicum* L.) Cultivation in Protected Agriculture

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Tomato (*Solanum lycopersicum* L.) is one of the most widely cultivated vegetable species worldwide, but bacterial wilt caused by *Ralstonia solanacearum* is the most severe soil borne disease threatening tomato cultivation in protected agriculture. Continuous monocropping encourages the growth of pathogens, while the chemical fumigants that were previously used, including methyl bromide, dichloropropene, metam sodium, and basamid, are now prohibited. The alternatives that are currently available are either expensive, environmentally harmful, or only partially effective. Chlorine based compounds have been widely used as soil sterilizers in commercial agriculture due to their broad-spectrum antimicrobial properties. The experiment was conducted using the tomato variety 'Sensation', which is one of the most susceptible tomato varieties to bacterial wilt. The pathogen was isolated on tetrazolium chloride medium, confirmed by the bacterial streaming test, and inoculated into soil with approximately 5.5×10^7 CFU/mL spore concentration five days before the treatment applications. The experiment followed a completely randomized design with eight treatments and twelve replicates each, such as untreated control (T1), steam sterilization (T2), bleaching powder at 0.05, 0.10, and 0.15% (T3-T5), and commercial chlorine bleach (Clorox) at 0.05, 0.10, and 0.15% (T6-T8). Results indicated that bleaching powder and Clorox sterilization did not significantly affect ($P > 0.05$) for the growth parameters tested; plant height (cm), nor the number of leaves per plant, but significantly affected ($P < 0.05$) for the yield parameters tested; fruit weight and the number of fruits per plant. The 0.15% bleaching powder treatment recorded the highest fruit weight, fruit number, and survival rate. Soil pH and electrical conductivity (mS/cm) stayed within ideal levels across treatments, indicating that chlorine applications did not disrupt soil balance. Furthermore, bacterial counts were substantially reduced under chlorine sterilization, with the lowest recorded in the 0.15% bleaching powder treatment. In contrast, untreated soil resulted in zero survival. These findings confirm chlorine, particularly bleaching powder at 0.15%, as an effective soil sterilizer for suppressing *R. solanacearum* and improving tomato yield under protected conditions. Bleaching powder can be recommended as a practical sterilant in commercial use for soil borne bacterial wilt management in tomato cultivation, with further studies needed to evaluate its efficacy across different soil types, concentrations, and long-term impacts on fruit quality.

Keywords: Bacterial wilt; chlorine; protected agriculture; soil sterilization; tomato



Paper ID: NSALS '26-098 (Oral)

Effects of Different Growth Media Compositions on *In-vitro* Propagation of *Brassavola nodosa* (L.) Lindl: A Hybrid Orchid

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Brassavola nodosa (L.) Lindl., which is commonly known as the Lady of the Night orchid, is a fragrant epiphytic orchid species with significant potential for commercialization as a potted ornamental plant. However, large-scale propagation of this orchid is limited by low seed germination, a lengthy time for vegetative propagation, and population reduction due to habitat destruction and overcollection from forests. Therefore, *in-vitro* propagation offers an alternative for rapid multiplication, conservation, and commercial production. This study aimed to evaluate the effects of different growth media compositions on *in-vitro* propagation of *Brassavola nodosa* to identify the most effective medium for optimizing shooting and rooting. Two experiments were conducted as completely randomized designs. In the first experiment, four growth media were tested on shooting, and the second experiment evaluated three media on rooting. Twenty-four replicates per treatment were used, with two plantlets per bottle. Variables tested included survival percentage, plant height, number of leaves, leaf length, number of shoots, shoot length, number of roots, and root length. Data were analyzed using one-way ANOVA, and mean comparisons were performed using the Tukey Test at $P < 0.05$. All media compositions resulted in 100% survival of plantlets during both the shooting and rooting phases. Statistically significant differences ($P < 0.05$) were observed among treatments for all measured variables at 10 weeks after culturing. For shooting, Murashige and Skoog (MS) medium supplemented with 0.1 mg/L Naphthaleneacetic acid (NAA), 2 mg/L 6-Benzylaminopurine (BAP), and 30 mg/L adenine sulfate was the most effective medium, producing superior shoot length and number of shoots. For rooting, the best performance was obtained with MS medium supplemented with 0.5 mg/L NAA and 0.75 mg/L Indole-3-butyric acid (IBA), which enhanced root number and root length. The study demonstrates that optimized growth media compositions can significantly improve the efficiency of *in-vitro* propagation of *Brassavola nodosa*.

Keywords: Benzylaminopurine; conservation; growing medium; indole butyric acid; naphthaleneacetic acid



Paper ID: NSALS '26-109 (Oral)

Evaluation of Paper-based Products Made from Fiber Extracted from Foliage and Bagasse of Sugarcane (*Saccharum officinarum* L.)

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Sugarcane (*Saccharum officinarum* L.) is one of the most important tropical crops, generating large quantities of residues such as bagasse after juice extraction, while its foliage remains in the field after harvesting. In Sri Lanka, bagasse is mainly used for energy production, whereas foliage is often burned or left unused, causing environmental concerns. These residues are rich in cellulose and can be used as sustainable alternatives to wood pulp in papermaking. The possibility of sugarcane bagasse and leaves of two commonly growing sugarcane varieties were tested as raw materials for paper making in this study. Fibers were extracted using alkali treatments (2% and 4% NaOH), followed by bleaching with NaOCl. Extracted fibers were characterized based on fiber yield, tensile strength, Fourier Transform Infrared Spectroscopy (FTIR), and X-ray Diffraction (XRD). Fibers treated with 2% NaOH and 6% NaOCl were used to prepare paper, and their thickness, grammage (GSM), and water absorption percentage were assessed. Both NaOH concentration and variety significantly influenced fiber yield, while their interaction was not significant. Increasing NaOH concentration from 2% to 4% improved fiber yield in both SL 00-354 and SL 96-128 varieties. The interaction between NaOH concentration and variety was significant for breaking load, indicating that alkali strength affected fiber strength differently across varieties. Removal of hemicellulose and lignin after NaOH treatments was confirmed by FTIR, while XRD indicated the preservation of cellulose I crystalline structure. Bagasse-based papers had greater thickness (0.141 mm) and GSM (53.43 g/m²) compared to foliage-based papers (0.1248-0.1280 mm and 45.48-48.07 g/m); no significant differences were observed in water absorption percentage, ranging from approximately 140% to 160%. Since the paper testing was conducted before pressing, the results reflect uncompressed sheet properties, further improvements are likely achievable through pressing and with suitable additives. The study highlights the potential of sugarcane residues as a renewable raw material for paper making, offering a sustainable solution to biowaste management, lessening dependence on wood pulp, and enhancing value addition to sugarcane waste.

Keywords: Bagasse; bio-waste; foliage; grammage; water absorption



Paper ID: NSALS '26-154 (Oral)

Management of Cucumber Mosaic Virus through Alternative Host Identification and Organic Plant Extract Applications

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Cucumber Mosaic Virus (CMV) is one of the most widespread and destructive plant viruses, infecting a wide range of host species and causing significant yield losses in cucurbits. Its non-persistent transmission by aphids limits the effectiveness of chemical control measures, creating the need for sustainable management strategies. The present study aimed to manage CMV through the identification of alternative weed hosts acting as virus reservoirs and to evaluate the efficacy of selected organic plant extracts against CMV infection in cucumber (*Cucumis sativus* L.). In the first experiment, twenty weed species were collected from CMV infected fields, and molecular detection using reverse transcription polymerase chain reaction (RT-PCR) confirmed CMV infection in four weed species: *Ageratum conyzoides*, *Macroptilium lathyroides*, *Melochia corchorifolia*, and *Ludwigia peruviana*. These species serve as alternative hosts, maintaining primary inoculum sources for field level infections. In the second experiment, cucumber plants were mechanically inoculated with CMV and treated weekly with aqueous extracts of *Mirabilis jalapa* (Hendirikka), *Tagetes* spp. (Marigold), *Cymbopogon citratus* (Lemongrass) and *Allium sativum* (Garlic), while sterile distilled water served as the control. Treatments were arranged in a Completely Randomized Design with five replications, and disease incidence was quantified as the percentage of infected leaves relative to the total number of leaves per plant and analyzed using ANOVA. CMV incidence differed significantly among treatments ($P=0.012$). The highest disease incidence was recorded in the control (62.40%), while all plant extract treatments significantly reduced CMV incidence. The lowest disease incidence was observed in *C. citratus* treated plants (6.42%), followed by *Tagetes* spp. (10.10%) and *Allium sativum* (12.20%). *Mirabilis jalapa* extract showed moderate suppression, with a disease incidence of 22.65%. Overall, organic plant extracts reduced CMV incidence by approximately 64-90% compared to the untreated control. These findings indicated that the integrated management practices combining weed host removal and application of organic extracts can effectively reduce CMV incidence in cucumber. The study highlights the potential of eco-friendly approaches in virus management, providing a sustainable alternative to chemical-based practices. Future work should focus on optimizing extract concentrations, exploring combinations, and validating field scale applications for farmer adoption.

Keywords: Alternative hosts; cucumber mosaic virus; disease management; organic plant extracts; weed reservoirs



Paper ID: NSALS '26-170 (Oral)

Evaluation of Different Potting Media Compositions and UV Exposure Durations for Acclimatization of *In-vitro* Cultured *Haworthia* (*Haworthia retusa*)

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Haworthia retusa is an economically significant succulent plant in the horticultural industry owing to its unique geometric shape with leaf colour variation. *In-vitro* propagation coupled with Ultraviolet (UV) radiation is commonly employed to produce phenotypic variations in plants; however, the lack of standardized potting media for acclimatization of such *in-vitro* propagated plants remains a constraint for sustained growth and long lasting desired phenotypic changes. In this study, six-month-old *in-vitro* propagated *Haworthia* plantlets, which were subjected to Ultraviolet-C (UV-C) radiation at 253.7 nm for 0, 30, 45, and 60 min, were introduced to six distinct potting media combinations at their acclimatization stage. The experiment was conducted using nine replicates in a two-factor factorial completely randomized design and analyzed growth parameters, including the plant height, number of leaves, crown diameter at four weeks intervals, while number of suckers, number of roots, average root length, and survival percentage after 12 weeks. Results showed that 100% survival percentage across all treatment combinations, indicating that *Haworthia retusa* exhibits a strong adaptability to acclimatization conditions. The interaction between UV exposure duration and potting media was statistically significant ($P < 0.05$) for plant height and number of roots; 30 min UV exposed plants grown in top soil:sand media and 45 min UV exposed plants grown in coir dust:sand:charcoal media, respectively. For number of leaves and crown diameter, a significant main effect ($P < 0.05$) was observed with 60 min of UV exposure and for average root length a significant main effect ($P < 0.05$) was observed in coir dust:sand:charcoal media. These results over 12 weeks provide a foundation for developing a standardized protocol for acclimatization of UV treated, *in-vitro* propagated *Haworthia* plants, while suggesting that a longer time period may be required for these traits to exhibit significant differences.

Keywords: Acclimatization; horticultural industry; *in-vitro* propagation; UV-C radiation



Paper ID: NSALS '26-188 (Oral)

Evaluation of Potting Media and Fertilizer Schedule for Enhancing Growth and Yield Performance of Zucchini (*Cucurbita pepo* L.) under Protected Cultivation

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Zucchini (*Cucurbita pepo* L.) is a vegetable crop with increasing demand in local and export markets due to its high nutritional value and short growth cycle. Locally developed and well-established agronomic protocols for zucchini cultivation are lacking, leading to suboptimal growth, yield variability, and inefficient resource utilization. This study aimed to identify the best combination of potting media and fertilizer schedule to enhance the growth and yield performance of zucchini in protected cultivation system. The experiment was conducted in a protected house at Uva Wellassa University of Sri Lanka. "Summer Squash Jewel" hybrid variety was used. A factorial completely randomized design was used with two factors: potting media and fertilizer (Albert's fertilizer) schedule. There were three potting media: (M1 - coir dust:paddy husk charcoal:compost 1:1:1 v/v; M2 - coir dust:coco chips 1:1 v/v; M3 - coir dust:paddy husk charcoal 1:1 v/v) and two fertilizer schedules [F1 - 0.5 g/plant/day (2 weeks), 1 g/plant/day (4 weeks), 1.5 g/plant/day (8 weeks); F2 - 1 g/plant/day (2 weeks), 1.5 g/plant/day (4 weeks), 2 g/plant/day (8 weeks)]. Media pH, electrical conductivity, and bulk density were analyzed. Growth parameters (plant height, stem girth, and number of leaves) and yield and quality parameters (number of fruits, fruit weight, fruit size, and total soluble solids) were evaluated. Data were analyzed using two-way analysis of variance. The interaction effect of potting media and fertilizer schedule was not significant for most of the measured parameters except fruit yield and number of fruits per plant. The M1F2 treatment combination produced a higher number of fruits per plant (3 ± 0.15) and the highest cumulative fruit weight (443.3 ± 32.24 g). Furthermore, potting medium M1 consistently yielded fruits of higher quality, with the highest dry matter content ($22.13 \pm 4.78\%$) and a larger average circumference of fruits (10.67 ± 0.36 cm). Overall, the study concludes that the potting medium consisting of coir dust: paddy husk charcoal: compost 1:1:1 v/v with the application of Albert's fertilizer 1 g/plant/day (2 weeks), 1.5 g/plant/day (4 weeks), 2 g/plant/day (8 weeks) as the most suitable for maximizing both the yield and quality of zucchini under protected cultivation.

Keywords: Fertilizer schedule; potting media; protected cultivation; yield performance; zucchini



Paper ID: NSALS '26-190 (Oral)

Root Knot Nematode (*Meloidogyne* spp.) Associated with Selected Solanaceous Crops in Central Province, Sri Lanka

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Root-knot nematodes (*Meloidogyne* spp.) are recognized as one of the most damaging plant parasitic nematodes affecting solanaceous crops such as tomato (*Solanum lycopersicum*), brinjal (*Solanum melongena*), and chilli (*Capsicum* spp.) worldwide. Their infestation causes the formation of characteristic root galls, stunted growth, and significant yield reductions, resulting in major economic losses. Despite their importance, there is limited information on the occurrence and distribution of *Meloidogyne* spp. in Sri Lanka. Therefore, this study was conducted to identify the *Meloidogyne* spp. associated with solanaceous crops and to determine their prevalence in the Central Province, Sri Lanka. A total of fifty-four (54) solanaceous crop fields, including tomato, brinjal, and chilli cultivation fields, were surveyed across major solanaceous crop-growing regions in the Central Province, namely Mulgama, Medapitiya, Delpitiya, Rabukpitiya, Abanwala, Kundasale, Muruthalawa, Thalathu Oya, Marassana, Namadagala, Nugethenna, Dabagahapitiya, Kaluthenna, Haguranketha, Rikillagaskada, Mathurata, Mandaram Nuwara, Walapane, Raagala, Theripehe, Thenna, Nalanda, Sigiriya, and five plants from each field were randomly sampled. Root samples were examined for galling, and if root galls were present, the samples were collected into labeled plastic bags and transported to the laboratory. Adult female nematodes were extracted using fine forceps under a dissecting microscope and preserved in 45% lactic acid. Species were identified based on perineal pattern morphology through microscopic observation. Distinct morphological features such as the dorsal arch shape, lateral lines, and striae patterns were compared with standard descriptions for species confirmation. The data were combined with GPS coordinates to prepare a nematode distribution map using ArcGIS software. Out of the total, ten fields were found to be infested with root knot nematodes, and the population comprised three species: *M. incognita*, *M. javanica*, and *M. arenaria*. Overall, *M. incognita* (44%) was the predominant root-knot nematode species, while *M. javanica* and *M. arenaria* constituted 37% and 19% respectively. *M. incognita* was dominant in brinjal and chilli fields (38 of 60 females), whereas *M. javanica* predominated in tomato fields (24 of 40 females). *M. hapla* was absent, confirming its rarity in tropical lowlands. Overall, the study documents the occurrence and distribution of root-knot nematode species in solanaceous crops cultivated in the Central Province, contributing valuable baseline data for future nematode management and research.

Keywords: Central province; *Meloidogyne* spp.; root-knot nematodes; solanaceous crops



Paper ID: NSALS '26-193 (Oral)

Identification of Agricultural Land Use Changes and its Driving Factors: A Case Study in Welimada Divisional Secretariat, Sri Lanka

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Changes in agricultural land use and land cover are caused by several factors. These changes affect the balance of nature and reduce agricultural productivity. Welimada Divisional Secretariat (DS) is a major potato and vegetable (beans, cabbage, tomato) producing region. The climate of the region, such as rainfall pattern, temperature, soil condition, and humidity, makes ideal conditions for potato and vegetable cultivation. However, in recent decades, this area has experienced a decline in agricultural productivity along with significant land use changes. This study aimed to identify agricultural land use changes and its driving factors from 2000-2025 in Welimada DS. Geographic Information System (GIS) and Remote Sensing techniques were used to identify land use changes using Landsat imagery. Normalized Difference Vegetation Index (NDVI), Normalized Difference Built up Index (NDBI), and supervised land use/ land cover classification maps were generated with overall accuracy above 89% for each year. A field survey was conducted in five Grama Niladhari divisions that showed the most significant changes to identify major drivers. Results indicated a decline in NDVI (-1.03%) and an increase in NDBI (+26.9%), and cultivated vegetation decreased by 28.78 km² while built-up areas increased by 10.3 km². The descriptive statistics of the field survey indicated that 90% of farmers had changed their land use, with the most common shift being paddy to vegetable cultivation (32%). Also, among environmental factors, high pest and disease outbreaks were perceived as the most important (50.4%). Under technical factors, poor access to irrigation facilities ranked as most important (69.11%), and among economic factors, high cost of production was identified as the most significant factor (66.49%). The Logistic Regression Model was significant ($P < 0.05$; Nagelkerke $R^2 = 0.727$), identifying environmental, economic, and technical factors as significant predictors and farmers' gender and education level as non-significant predictors. These results show the need for actions to support sustainable land management in Welimada DS.

Keywords: Binary logistic regression; field survey; GIS and remote sensing; land use change; NDVI and NDBI



Paper ID: NSALS '26-215 (Oral)

Effect of Palmyrah (*Borassus flabellifer* L.) Seed Shell Biochar on Growth and Yield of Okra (*Abelmoschus esculentus* L.) and Soil Improvement

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Palmyrah (*Borassus flabellifer* L.) is a widely distributed palm species whose seed shells are a low-cost biomass resource. Excess chemical fertilizer usage has become a major threat in agriculture. This study aimed to produce biochar from palmyrah seed shells and evaluate its potential as a sustainable soil amendment to enhance the growth and yield of okra (*Abelmoschus esculentus* L.) and soil fertility level. Biochar was produced using the Drum Method at 300-600°C for three hours under oxygen-limited conditions. The experiment was designed in a completely randomized design with 7 treatments and 3 replicates: T1 - control (only soil); T2 - soil + biochar (165 g); T3 - soil + cow dung (1:1); T4 - soil + cow dung (1:1) + biochar (50 g); T5 - soil + cow dung (1:1) + biochar (100 g); T6 - soil + cow dung (1:1) + biochar (165 g); T7 - soil + cow dung + biochar (165 g) + chemical fertilizer (as recommended by the Department of Agriculture). Biochar quantities of 50, 100, and 165 g correspond to the application rates of 3, 6, and 10 t/ha, respectively. Soil samples were analyzed before and after the experiment for pH, electrical conductivity (EC), available nitrogen (N), available phosphorus (P), exchangeable potassium (K), and organic matter (OM) content. Biochar was characterized for pH, EC, and organic carbon (OC). The thermal stability of biochar was assessed using thermogravimetric analysis. Growth and yield parameters of okra, including plant height, number of leaves, fruit count, and total yield were measured. Data were subjected to analysis of variance, and mean separation was performed with Tukey's test at the 5% probability level. Results revealed that biochar application significantly ($P < 0.05$) affected the okra growth and yield. Soil properties like EC, N, P, K, and OM showed significant ($P < 0.05$) differences. Moisture, volatile matter, fixed carbon, and ash contents of biochar were 10.5, 26.0, 4.3, and 5.9%, respectively. The best results were obtained from T6. Treated plants grew taller (118.5 cm), developed more fruits (26.33), leaves (39.66), and delivered a total yield of 638.3 g, showing substantially higher values than those of all other treatments. Overall, palmyrah seed shell biochar enhanced crop performance and soil improvements. Long-term studies are recommended to further confirm the findings.

Keywords: Biochar; palmyrah seed shell; soil fertility; thermo gravimetric analysis (TGA)



Paper ID: NSALS '26-023 (Poster)

Effectiveness of Coconut Water Supplemented NPK Fertilizer on the Growth and Yield of Chilli MICH HY 01 (*Capsicum frutescens* L.)

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This study investigated the effectiveness of coconut water supplemented NPK (12:6:12) fertilizer on the growth and yield performance of chilli (*Capsicum frutescens* L., MICH HY 01) under protected-house conditions at Eastern Fertilizer Company (Pvt.) Ltd., Kappalthurai, Trincomalee, Sri Lanka, from March to July 2025. Coconut water was used as a natural bio-stimulant due to its rich content of phytohormones, minerals, and organic compounds, which can enhance nutrient uptake and plant growth when supplemented with inorganic fertilizers. The experiment was arranged in a completely randomized design with six treatments and five replicates. Treatments included: T1 - control; no nitrogen (N), phosphorus (P), and potassium (K) or coconut water; T2 - 100% coconut water; T3 - NPK alone applied at the Department of Agriculture, Sri Lanka, recommended rate; T4 - NPK + 10% coconut water; T5 - NPK+15% coconut water; and T6 - NPK + 20% coconut water. Coconut water concentrations were selected based on previous studies and preliminary observations. Coconut water was freshly collected, filtered, measured to the respective amount, and applied to the soil in combination with NPK fertilizer to chilli plants. Growth parameters (plant height, number of leaves, number of branches, and leaf greenness) were assessed biweekly, while yield attributes (number of fruits/plants, average fruit weight, and total yield/plant) were measured at the harvesting time. Soil properties were analyzed before and after treatments. Data were subjected to analysis of variance, and treatment means were separated by Tukey's HSD test at $P \leq 0.05$. Results indicated a significant ($P < 0.05$) effect of treatments. T5 consistently showed the best performance, recording the highest vegetative growth and yield attributes. At the first harvest (10 weeks after planting), T5 achieved an average yield of 55.56 ± 5.29 g/plant, while at the peak harvest (12 weeks after planting) it produced 68.92 ± 1.41 g/plant, indicating optimal nutrient and bio-stimulant interaction. Although T6 showed the highest values for the post-trial soil fertility indicators (soil pH 7.53; available N 430.80 mg/kg; available P 20.88 mg/kg; exchangeable K 250.86 mg/kg; organic matter 2.56%; electrical conductivity 1.75 dS/m), it did not translate into higher yield suggesting that excessive coconut water (20%) supplementation may induce osmotic stress or nutrient and hormonal imbalance. The findings highlight that supplementation of NPK fertilizer with 15% coconut water proved to be the most effective treatment for maximizing chilli growth and yield while maintaining soil health under protected-house cultivation. This integrated fertilization approach demonstrates a strong potential for sustainable and resource-efficient chilli production in Sri Lanka.

Keywords: *Capsicum frutescens* L.; chilli MICH HY 01; coconut water; NPK fertilizer



Paper ID: NSALS '26-113 (Poster)

Comparison of Growth Performances of Selected Tea (*Camellia sinensis* [L.] O. Kuntze) Cultivars under Medium-sized Coir-pith Pellets and Conventional Soil Media at the Nursery Stage

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The selection of an appropriate growing medium is crucial for successful tea (*Camellia sinensis* (L.) O. Kuntze) propagation. However, conventional soil-based media pose significant economic and environmental challenges. Tea nursery management faces challenges such as topsoil scarcity, high labor costs, and environmental concerns associated with the conventional soil-based media. This study evaluated the viability of coir pith as a sustainable alternative to the conventional soil-based potting media for tea propagation. Here, medium-sized coir pith pellets (6 x 9.5 cm) and similar-sized soil pots with soil volume were used for nursery propagation. Two cultivars, TRI 3072 and TRI 4053, were propagated using conventional soil and coir pith pellets, and 250 vegetative cuttings were used from each cultivar. A completely randomized design was employed as the experimental design. Growth parameters, including leaf count, leaf area, SPAD value, shoot height, root length, shoot dry weight, and root dry weight, were measured at 8, 12, 16, 20, and 24 weeks after planting. Root morphological traits were analyzed. A cost comparison was conducted to assess economic feasibility. The data were analysed using Minitab 18 statistical software. Results indicated no significant differences ($P > 0.05$) in most growth parameters between soil and coir pith media, except for SPAD values in TRI 3072 at 20 and 24 weeks after planting. However, root architecture differed; soil-grown plants exhibited wider root angles, while coir pith promoted deeper, narrower roots. The cost per pellet for coir pith was Rs. 51.95, while the cost per soil pot was Rs. 44.15. Considering ease of transport in hilly terrain along with reduced labour and water requirements, coco pith pellets serve as a viable alternative to soil-based tea nurseries. The study concludes that medium-sized coir-pith pellet is an effective, eco-friendly, easy-to-transport alternative to conventional soil media, supporting comparable tea seedling growth with improved resource efficiency for tea nurseries.

Keywords: *Camellia sinensis*; coir pith pellets; nursery management; root morphology; shoot morphology



Paper ID: NSALS '26-145 (Poster)

Comparative Study of Long-term Bed Systems and Crop Rotation on the Sustainability of Sweet Potato Farming

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Sweet potato (*Ipomoea batatas*) is an important food crop in Sri Lanka, but its long-term productivity is challenged by soil degradation, pest infestations, and yield instability caused by continuous monocropping and conventional tillage. This research aimed to compare the effects of long-term bed systems and crop rotation under different cropping systems on soil health and sweet potato farming, providing insights into sustainable cultivation practices. The study was conducted over five consecutive cropping seasons at the Sustainable Agriculture Research and Development Centre, Makandura, using a randomized complete block design with four treatments and five replicates. Treatments were conventional land preparation with fallow (T1), conventional land preparation with compost ridge topping and fallow (T2), conventional land preparation followed by sorghum rotation without further land preparation (T3), and compost ridge topping followed by sorghum rotation without further land preparation (T4). Soil properties, nematode populations, weed density, growth parameters, and yield parameters were measured. Data were analyzed using one-way Analysis of Variance in SAS software (Version 9.4), and mean separation was performed using Duncan's Multiple Range Test at the 5% significance level ($P \leq 0.05$). Results indicated that growth parameters such as vine length, leaf area, and chlorophyll content did not differ significantly among treatments. Treatments involving sorghum rotation (T3 and T4) recorded lower nematode populations and weed density. Tuber yield was significantly higher ($P < 0.05$) in T4, showing a clear improvement compared with T1 (conventional treatment). Bulk density also differed significantly among treatments, with T4 recording the lowest value. However, most other soil physical and chemical properties did not change significantly during the study period, highlighting the need for long-term monitoring to capture substantial improvements in soil fertility. Overall, T4 was identified as the best treatment in this study, as it produced the highest yields while effectively reducing nematode populations and weed density, thereby supporting the long-term viability of sweet potato farming in Sri Lanka.

Keywords: Compost ridge topping; conventional land preparation; crop yield; fallow; sorghum rotation



Paper ID: NSALS '26-206 (Poster)

Evaluation of Different Ethephon Concentrations on Vegetative Characteristics, Flowering, and Yield Performance of Cucumber (*Cucumis sativus* L.)

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Cucumber is an economically important vegetable crop in Sri Lanka, but its productivity is often limited by excessive male flowering due to unbalanced sex expression. This study was undertaken to investigate how different concentrations of ethephon influence vegetative growth, sex expression, and yield performance in cucumber, with the aim of improving overall productivity. Three varieties of Sri Lankan cucumber, HORDI White (V1), Kalpitiya white (V2), and Gannoruwa white (V3) were tested using a randomized complete block design with two blocks for each variety, eight sample units for each treatment and five concentrations of ethephon: T1 - 0 ppm (control), T2 - 100 ppm, T3 - 200 ppm, T4 - 300 ppm and T5 - 400 ppm. Treatments were applied twice at the 2-4 and 7-8 true leaf stages (days after planting) to field-grown plants at the Horticultural Crop Research and Development Institute (HORDI), Gannoruwa, Sri Lanka, covering a total of 240 experimental units. At two weeks after treatment (WAT), no significant differences ($P>0.05$), but by five WAT, plant height was significantly reduced by ethephon. Control plants recorded the highest growth (V1 - 311.50±18.75 cm), while the shortest were observed at 200-300 ppm (V2 - 193.50±11.75 cm and V3 - 191.88±6.63 cm). Branching was promoted, with the highest value (9.25±0.88 cm) observed in V3 at 100 ppm. Ethephon markedly shifted sex expression, in which the control treatment produced the highest male flowers (21.00±1.00 in V3 at 4 WAT), whereas 200 ppm significantly reduced male flowers ($P<0.05$) and enhanced female flowers (4.50±0.00 in V3). Yield efficiency was maximized at 200 ppm among three varieties, and the variety V3 produced 15.75±0.75 fruits/plant and 9801.36±240.14 g yield/plant. Fruit quality characters, including fruit weight (874 g in V2) and fruit circumference (26.12 cm in V3), also maximized at 200 ppm, while the Brix value was not significantly affected. In conclusion, both 100 ppm and 200 ppm ethephon concentrations significantly improved female flower production and yield performance. Although 200 ppm showed the highest mean values, statistical analysis revealed no significant difference between 100 ppm and 200 ppm. Therefore, 100 ppm is recommended as the most effective concentration of ethephon due to its lower dosage, cost-efficiency, and comparable productivity.

Keywords: Cucumber; ethephon; fruit quality; sex expression; yield performance



Paper ID: NSALS '26-213 (Poster)

RAG-enabled Intelligent Crop Recommendation System

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Agriculture is a critical sector for food security and economic growth, particularly in developing regions where a large portion of the population depends on farming. However, farmers often face difficulties in selecting suitable crops due to unpredictable climatic conditions, declining soil fertility, and the gradual loss of traditional agricultural knowledge. This study presents an intelligent crop recommendation and advisory system that integrates machine learning with a Retrieval-Augmented Generation (RAG) framework to support farmers in making informed cultivation decisions. The system combines quantitative environmental data with qualitative expert insights, creating a balanced approach between data-driven prediction and field experience. The dataset used for model development consisted of 2,200 samples covering 22 crop types such as rice, maize, and wheat, sourced from Kaggle. Seven key soil and environmental parameters were used as input features, including nitrogen, phosphorus, potassium, pH, temperature, humidity, and rainfall. After data preprocessing and feature selection, two ensemble learning algorithms, Random Forest and XGBoost, were trained and evaluated. The XGBoost model achieved slightly better performance, exceeding Random Forest by 0.5% in F1-score, with an accuracy of 98.86%, precision of 98.97%, recall of 98.87%, and an F1-score of 98.5%. The RAG module, implemented using LangChain and ChromaDB, retrieved contextually relevant information from a curated expert knowledge base and generated advisory responses within an average of four seconds. This integration allowed the system to provide both accurate crop recommendations and context aware management suggestions, such as fertilizer scheduling, irrigation practices, and pest control measures. The proposed system effectively bridges the gap between predictive analytics and local agricultural knowledge. By preserving and utilizing the knowledge of experienced farmers, it empowers smallholders and new generation farmers to make better decisions, enhance productivity, and promote sustainable farming practices. This research contributes toward building an intelligent and inclusive agricultural ecosystem suited for real-world conditions.

Keywords: Agriculture, context awareness, crop recommendation, expert knowledge, retrieval-augmented generation



ENVIRONMENTAL SCIENCE AND CLIMATE CHANGE

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Paper ID: NSALS '26-027 (Oral)

Multi-matrix Investigation of Microplastics in the Negombo Lagoon, Sri Lanka

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Coastal lagoons serve as transitional zones that can act as both sinks and sources of microplastics (MPs), accumulating them in sediments and water while releasing them into adjacent marine environments. However, studies on MPs accumulation across different matrices (water, sediment, and biota) and their transfer from plankton to higher trophic levels in coastal lagoons remain limited. This study aimed to assess MP abundance in different matrices; examine the relationship between MP abundance in planktons and selected invertebrates with their trophic levels; and characterize extracted MPs from different matrices in the Negombo lagoon, one of the most polluted coastal lagoons in Sri Lanka. Wet peroxide oxidation and saturated NaCl (1.2 g/cm³) based density separation were used to extract MPs from water and sediment, respectively. MPs in plankton (phytoplankton, zooplankton), bivalves (*Saccostrea cucullata*, *Mercenaria mercenaris*, *Tegillarca granosa*), shrimps (*Penaeus monodon*, *Penaeus indicus*), and crabs (*Scylla serrata*, *Portunus pelagicus*, *Portunus sanguinolentus*) were extracted by digesting organic matter with 10% KOH, followed by density separation using saturated NaCl. The extracted MPs were observed under a stereomicroscope to determine their size, color, and morphotype. Polymer composition of MPs was identified using ATR-FTIR analysis. The average MP abundance in water and sediment was 24.94±1.85 particles/L and 92.5±4.41 particles/kg dry weight, respectively. There was a significant difference in MP abundance among plankton groups and invertebrate species in this study (Kruskal-Wallis test, $P < 0.05$). The lowest MP abundance was recorded in phytoplankton (0.0012±0.0002 particles/g wet weight), whereas the highest was observed in *S. serrata* (3.33±0.24 particles/g wet weight). Small (<1 mm) blue fibers, likely originated from fishing nets, dominated across all matrices, indicating that MPs in plankton and invertebrates in this study are primarily ingested from water and sediment in their habitat. Moreover, a significant positive correlation ($R_{\text{Spearman}} = 0.8$, $P < 0.05$) between MP abundance and trophic level suggests potential trophic transfer of MPs along food chains, highlighting risks to seafood safety. Low-density polyethylene was the most prevalent polymer (40%), followed by polypropylene (20%), polystyrene (10%), ethylene-propylene copolymer (10%), polyvinyl acetate (10%), and polyvinyl chloride (10%). MPs accumulated in different matrices in Negombo lagoon facilitating their transfer along food chains. Therefore, implementation and monitoring of proper plastic pollution control measures are crucial to protect both ecosystems and human health.

Keywords: Food chain; invertebrates; planktons; sediment; trophic transfer; water



Paper ID: NSALS '26-074 (Oral)

Detecting Microplastic's Bioaccumulation in Red Earthworm *Eisenia fetida* (Savigny, 1826) via FTIR Assay

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Microplastics (MPs) are smaller than 5 mm in size and recognized as emerging persistent pollutants in agro-ecosystems through leaked sewage sludge, plastic mulching, and compost. The effects of MPs on earthworms remain inadequately understood. This study investigates the bioaccumulation of MPs and their effects on *Eisenia fetida* using Fourier Transform Infrared (FTIR) assay. Twelve 10 kg capacity bins, each containing 2 kg of cow dung slurry and 1 kg teak leaves (2:1) were used for the experiment. Four treatments were established: T1 (control, without MPs), T2 (5 g MPs), T3 (10 g) and T4 (50 g) respectively. A total of 100 earthworms were carefully weighted and released into each treatment. The treatments were arranged in completely randomized design. Collected data were subjected to ANOVA and Duncan's multiple range test for mean separation using SAS 9.4 version. Weight of earthworms were recorded every 14 days for 45 days. Earthworms' samples 5% were collected from each treatment and subjected to FTIR analysis to quantify the bioaccumulated MPs. The initial mean weight across the treatment was 2.15±0.10 mg. After 45 days, control group showed significantly increased biomass of 130±0.06% (2.81±0.08 mg), whereas in T2 (5 g MPs) showed biomass decrease of 13±0.09% (1.89±0.11 mg) at $P<0.05$. In contrast, highly significant weight loss occurred in T3 (10 g) and T4 (50 g) treatments, with average biomass loss of 25±1.09% and 35±0.79%, respectively, in comparison to initial body weight at $P<0.05$. Further, MPs reduced composting efficiency by extended composting period. The FTIR analysis showed similar absorption peaks centered at approximately 720/cm and 1460/cm, suggesting a predominance of polyethylene like polymeric compounds. T1 showed very weak peaks, suggesting minimal or no polymer presence in the gut while T2 and T3 exhibited moderate peaks, indicating uptake and retention of MPs. T4 showed highest absorbance values, reflecting greater MPs accumulation in gut samples. This study highlights the ecological risk of microplastics in soil ecosystems and suggests the need for regulating plastic waste disposal and monitoring compost input to ensure sustainable vermicomposting.

Keywords: Bioaccumulation; earthworms; *Eisenia fetida*; microplastics; vermicompost



Paper ID: NSALS '26-081 (Oral)

Biomass and Sediment Carbon Stocks in Seagrass Meadows of Jaffna Lagoon, Sri Lanka

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Seagrass ecosystems are recognized as important blue carbon (C) ecosystems due to their ability to store C in both biomass and surrounding sediments, thereby playing a significant role in climate change mitigation. However, studies on the C storage capacity of seagrass ecosystems in Sri Lanka, particularly in the Jaffna lagoon, are limited. Therefore, this study was designed to quantify organic C in sediments and biomass (above and belowground) of seagrass meadows across selected locations in the Jaffna lagoon. Aboveground and belowground vegetation samples (n=9/transect) and sediment core samples from vegetated and non-vegetated sites (0-30 cm; n=9/transect) were collected along 50 m transects laid perpendicular to the shoreline. Leaves, shoots, and stems (aboveground biomass), and roots and rhizomes (belowground biomass) were separately oven-dried at 72°C until a constant weight was achieved to calculate biomass C storage. Sediment organic C content was quantified using the loss-on-ignition method. Five seagrass species were recorded: *Enhalus acoroides*, *Thalassia hemprichii*, *Halodule pinifolia*, *Thalassodendron ciliatum*, and *Halophila ovalis*. There was a significant difference in total sediment core organic C content among vegetated sites (t-test, $P < 0.05$). The highest total sediment core organic C content in vegetated sites was recorded at Gurunagar (91.72±11.33 Mg C/ha), while the lowest was recorded at Columbuturai II (11.18±3.85 Mg C/ha). *E. acoroides* exhibited the highest biomass C in both aboveground (1.24±0.15 Mg C/ha) and belowground (2.16±0.25 Mg C/ha) components. The lowest total biomass C was recorded in *H. ovalis* (0.20±0.03 Mg C/ha). The total sediment core organic C content was significantly higher than the total biomass C content across all study sites (t-test, $P < 0.05$). This is likely due to the role of sediments as long-term C sinks, where organic matter accumulates and is preserved over extended periods. Seagrass meadows in the Jaffna lagoon play an important role in biomass C sequestration, with sediments acting as the primary long-term organic C reservoir. Therefore, the conservation and management of seagrass ecosystems in the Jaffna lagoon are crucial for maintaining and enhancing their C sequestration capacity.

Keywords: Aboveground biomass; belowground biomass; blue carbon; climate change mitigation; *Enhalus acoroides*



Paper ID: NSALS '26-093 (Oral)

Assessment of Macro Litter on Selected Locations of the Southern Coast of Sri Lanka

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Macro litter (size > 2.5 cm) accumulation in the coastal zone has become a critical environmental issue due to its impacts on both coastal and marine environments. However, data on macro litter abundance and distribution in Sri Lankan coastal zones remain limited. This study was conducted to assess the abundance and composition of marine macro litter and their spatial variation along 9 selected beaches on the southern coast of Sri Lanka: Ginthota, Jungle beach, Polwathumodara, Mirissa, Thotamuna, Hiriketiya, near Tangalle Fishery harbor, Rekawa sea turtle nesting beach, and Godawaya, from May to July 2025. Macro litter surveys were conducted following UNEP/IOC guidelines. A 1,000 m² transect (100 m × 10 m) was established along the coastline, and within each transect, 05 sub-sites of 100 m² were selected, except at Jungle beach. At Jungle beach, a 500 m² transect was deployed due to the limited beach area. All visible macro litters in the selected sub-sites of each transect were collected and categorized according to material type (fabric, glass, metal, plastic, processed lumber, rubber and other or unclassified), pre-disposal usage (end consumer products, fishery debris, industrial debris and packaging materials) and origin (foreign and local). The Clean Coast Index (CCI) was calculated to evaluate beach cleanliness. A total of 5,954 litter items were collected. There was a significant difference in macro litter abundance among the beaches (Kruskal-Wallis test, $P < 0.05$). Thotamuna, located at the mouth of the Nilwala river, recorded the highest litter abundance (389.6 items/100 m²), highlighting the role of rivers in transporting inland macro-litter to coastal environments. In contrast Rekawa sea turtle nesting beach recorded the lowest abundance (0 items/100 m²), likely due to effective conservation and management practices. Locally originated litter, plastics, and packaging materials were the dominant litter origin, material type, and pre-disposal usage category, respectively (>50%). Thotamuna, Jungle beach, and the beach near Tangalle fishery harbor were categorized as 'extremely dirty' (CCI > 20). The results highlighted the strong influence of rivers in transporting debris to the coastal zone, improper domestic, industrial and fishery waste disposal, and tourism-related activities on macro litter accumulation in the southern coast of Sri Lanka. Implementation of proper coastal waste management strategies, strict regulations on plastic use, and community-based awareness programs are crucial to controlling macro litter pollution in the coastal zone of Sri Lanka.

Keywords: Clean coast index; Nilwala river; plastic; pre-disposal usage; UNEP/IOC guidelines



Paper ID: NSALS '26-097 (Oral)

Quantitative and Qualitative Analysis of Visually Observed Coastal Debris along the Hambantota Coastline, Sri Lanka

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Debris accumulation is a growing environmental concern in multiple coastal ecosystems. Scientific data on coastal debris distribution and abundance are important for effective waste management and policy formulation at the national level. The Hambantota coastal belt in the southern Sri Lanka is a socioeconomically important zone for local tourism, fisheries, and harbor operations. However, qualitative and quantitative data on coastal debris are limited in this beach area. This study aimed to assess the density, composition and spatial distribution of visually observable debris on Hambantota beach. This study was conducted at six selected sub-sites considering multiple anthropogenic activities and coastal usage patterns along Hambantota beach during April to June 2025. A systematic sampling method was used to collect the debris from three zones (intertidal, mid-intertidal, and supralittoral zones) using a 50 m line transect parallel to the shoreline. Debris was initially categorized based on the standard protocol and classified further into size classes: macro (>25 mm), meso (5–25 mm), and micro (<5 mm) debris. According to the results, there was a significant spatial difference in debris count density along Hambantota beach ($P < 0.05$). Sub-sites 01 and 02, located within the fishery harbor areas, recorded the highest litter density (8.56 ± 4.86 and 8.38 ± 4.89 items/m²), accounting for almost half of the total debris, while the lowest count density (0.92 ± 0.53 items/m²) was recorded for the isolated recreational site. In contrast, debris weight density was highest in sub-site 03 (248.00 ± 509.00 g/m²) due to the accumulation of characteristic rubber and metal wastes, though overall spatial variation of weight density was not significant ($P > 0.05$). The spatial distribution of beach debris primarily depends on the on-site waste disposal by anthropogenic activities and environmental factors (e.g., surface run-off). General plastic was the dominant debris category, with a total density (>330 items/m²) across all sites, compared to other major debris types highlighting the emerging health and safety risks. Macro-debris was the dominant size class (79.27%), followed by meso-debris (19.05%), and micro-particles (1.68%). The Clean Coast Index (CCI) highlighted "extremely dirty" level for the majority of beach sub-sites (CCI > 20) except the sub-site 06 ("Dirty", CCI = 19.6). CCI suggested that this beach area is severely affected by debris accumulation through littering, mainly plastics. These findings emphasize the need for a sound waste management program and public awareness campaigns for stakeholder groups toward a clean beach system.

Keywords: Clean coast index; coastal debris accumulation; plastic abundance; spatial differences; waste management



Paper ID: NSALS '26-101 (Oral)

Assessment of Riverbank Morphological Dynamics Caused by the Gem Mining Activities along the Tributary of Kalu River Basin in the Elapatha DS Division - Rathnapura, Sri Lanka

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Sri Lanka's gem mining industry plays an important role in local livelihoods and the country's economy. But it poses challenges to the aquatic ecosystems. The objective of this study is to analyze the gem mining trends from 2016 to 2024 and assess river morphological changes along the Hangamu river in Elapatha, Sri Lanka, to understand the environmental impacts of gem mining activities. Secondary data, i.e., Licenses issued for gem mines from 2016-2024 were gathered from the National Gem and Jewelry Authority regional office, Rathnapura. Riverbank changes under the selected two gem mining sites where mines are active were evaluated using Google Earth Pro imagery and Digital Shoreline Analysis Systems (DSAS 5.0) using ArcGIS. Shoreline Change Envelope (SCE), Net Shoreline Movement (NSM), End Point Rates (EPR), Linear Regression Rates (LRR) metrics were used to measure the bank erosion and sediment accretion patterns. The results revealed that traditional gem mining and mechanized gem mining have increased considerably during the study period. Riverbank morphological changes analysis indicated that the dynamics of shoreline morphology as riverbank accretion in the Raddella gem mining site region, while the eroding effect is shown in the Karangoda gem mining site. The results showed notable variation between the two related gem mining sites, with the given mean values of NSM=5.21±2.88 m, SCE=13.00±2.10 m, EPR=0.84±0.46 m, and LRR=1.36±0.41 m for the Raddella gem mining site, identifying dominant accretion trends along the riverbank. Karangoda gem mining site showed NSM=-1.97±1.12 m, SCE=11.65±5.08 m, EPR=-0.28±0.18 m, LRR=-0.85±0.27 m indicating clear erosion effect. Morphological metrics indicated that mechanized gem mining activities have impacted riverbank dynamics. Riverbank accretion results from the disposal of excavated soil into the river using heavy machinery, whereas riverbank erosion is mainly caused by gem mining activities along the riverbanks. These findings highlight these intensified and unregulated gem mining activities contribute to destabilizing the stable riverbanks and morphological variations, leading to serious environmental risks to the studied tributary of the Kalu river basin.

Keywords: Accretion; erosion; gem mining; river morphology dynamics



Paper ID: NSALS '26-125 (Oral)

Assessment of Morphometric Characteristics and Land Use Land Cover Changes in Upper Maha Oya River Basin, Sri Lanka

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Morphometric analysis combined with Land Use Land Cover (LULC) assessment provides critical insights into the hydrological behaviors of river basins and landscape dynamics. The present study evaluates the morphometric characteristics and LULC changes of the upper Maha Oya river basin, Sri Lanka, using Geographic Information System to support sustainable river basin management. A 30 m resolution Digital Elevation Model (DEM) was generated from 1:50,000 scale digitized contour data obtained from the Survey Department of Sri Lanka using the topo to raster interpolation method in ArcGIS 10.8, projecting to WGS 1984 UTM zone 44N. Drainage networks and watershed boundaries were extracted through standard hydrological processing, including sink filling, flow direction, and flow accumulation analysis. Morphometric parameters representing linear, areal, and relief aspects were computed following established geomorphological methods. The accuracy of basin delineation and stream extraction was validated through visual cross-verification with topographic maps and Survey Department drainage layers. The drainage density (0.72 km/km²) and stream frequency (1.99 streams/km²) indicate a coarse drainage texture, high infiltration potential, and delayed runoff response. Basin shape indices such as form factor (0.18), circularity ratio (0.21), and elongation ratio (0.48) revealed an elongated basin shape, suggesting lower flood susceptibility and extended runoff concentration time. Relief parameters, including the relief ratio of 0.02 and the ruggedness number of 0.49, reflected moderate relief and erosion potential. LULC analysis for the years 1999 and 2016 revealed notable landscape transformations. Cultivation areas, bare land areas and water areas have decreased by 17.83%, 2.59%, and 0.12% respectively, while built-up areas, forest covers and rock exposure have increased by 16.02%, 4.16%, and 0.58% respectively. These changes were primarily driven by population expansion, infrastructure development, urban expansion, and shifts in agricultural practices. Aforementioned changes may alter infiltration rates, surface runoff, and sediment transport processes in river basins. The integrated assessment of morphometric characteristics and LULC dynamics provides essential insights into the river basin's hydrological response and underscores the importance of sustainable land management practices to mitigate potential adverse impacts on the basin's hydrological regime. Further emphasize the need for sustainable land use planning in the Upper Maha Oya river basin.

Keywords: ArcGIS; DEM; hydrology; land use land cover change; morphometric analysis; upper Maha Oya river basin



Paper ID: NSALS '26-136 (Oral)

Abundance, Composition and Spatial Distribution of Coastal Macro Debris along the Southern Gampaha Coastline, Sri Lanka

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Accumulation of coastal macro-debris along Sri Lanka's shorelines poses a serious threat to marine ecosystems, the tourism economy, and public health. The lack of comprehensive baseline data limits effective, evidence-based management efforts. This study investigates the extent, composition, and spatial distribution of coastal macro-debris along the southern Gampaha coastline, addressing a critical knowledge gap in coastal pollution assessment. Shoreline surveys were conducted at five selected beaches including Sarakkuwa, Thaldiyawaththa, Dikowita, Preethipura and Palliyawaththa, between May and July 2025, following the modified NOAA Marine Debris Monitoring Protocol. At each beach, a 100 m × 10 m shoreline segment was established and divided into twenty transects, each 5 m in length, from which four were randomly selected during each of the three survey rounds. UNEP guidelines were followed for macro-debris classification. Statistical analysis was conducted using one-way ANOVA to evaluate spatial variations in macro-debris abundance among sites. Plastic pollution and beach cleanliness were calculated using standardized indices: Plastic Abundance Index (PAI) and Clean Coast Index (CCI). A total of 2,284 debris items were recorded across the surveyed beaches (surveyed beach area: 3000 m²). Highest densities were recorded at Preethipura (0.87 items/m²) and Dikowita (0.83 items/m²) with an overall mean of 0.76±0.09 items/m². One-way ANOVA revealed no statistically significant difference in debris abundance among sites ($P>0.05$). Plastic was the dominant debris type (55.34%), followed by foamed plastics (14.49%), rubber (8.54%), and other materials collectively accounted for the remaining proportion. PAI values ranged from 3.62 to 4.70, placing all beaches in "High Abundance" category. CCI values ranged from 12.97 to 17.43, categorizing all beaches as "Dirty". Dikowita exhibited the highest CCI value, indicating a coastal pollution hotspot likely influenced by nearby fishing activities. This study provides essential baseline data documenting macro-debris pollution along southern Gampaha coastline, influenced by both land and ocean-based anthropogenic activities. All surveyed beaches exhibited high plastic abundance and poor cleanliness, with Dikowita identified as a priority intervention site. These findings emphasize the urgent need for site-specific coastal management strategies, including enhanced waste infrastructure, stricter enforcement, cleanup programs, and continuous monitoring to mitigate threats to ecosystems and the tourism economy.

Keywords: Beach cleanliness; clean coast index; coastal management; plastic abundance index; plastic pollution



Paper ID: NSALS '26-155 (Oral)

Effect of the ENSO Events on the Seasonal Variability of Precipitation over Sri Lanka

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The influence of the El Niño–Southern Oscillation (ENSO) on rainfall variability within Sri Lanka's four climatic zones of wet, dry, intermediate, and semi-arid was investigated for the 1990–2023 period. Monthly rainfall records from 17 meteorological stations were evaluated using correlation and composite methods. Analyses employed the Standardized Precipitation Index (SPI) for hydroclimatic extremes and the Mann–Kendall test for trend detection. ENSO episodes were classified based on Niño 3.4 sea surface temperature anomalies and were further categorized by intensity. The findings demonstrated distinct spatial and seasonal variations in ENSO impacts at the zonal level, only the semi-arid zone showed a statistically significant but weak positive correlation with ENSO ($P < 0.05$, $R = 0.12$) while the other zones exhibited no significant relationships ($P > 0.05$). Seasonal analysis highlighted significant ENSO influence on rainfall during specific monsoon periods. ENSO significantly influenced Northeast Monsoon rainfall (NEM) in the wet and dry zones ($P < 0.05$), and the Second Inter-Monsoon (SIM) in the intermediate and dry zones ($P < 0.05$). Composite analyses further showed that La Niña events enhanced rainfall in the NEM, especially in the dry and intermediate zones. El Niño was linked to reduced NEM rainfall but increased SIM rainfall in the wet zone. The 3-month SPI analysis indicated that ENSO extremes were key drivers of hydroclimatic irregularities. The semi-arid zone was the most sensitive, with Hambantota exhibiting a more balanced occurrence of extremes, while Mannar experienced droughts during El Niño years. However, only the semi-arid zone exhibits a statistically significant, strong positive annual trend ($Z_c = 5.02$, $P < 0.05$). The dry, wet, and intermediate zones were shown no statistically significant annual trends ($P > 0.05$), according to the Mann-Kendall trend test. This suggests that any long-term trends indicative of climate change was largely overshadowed by natural variability during the research period. These findings demonstrate that influence is not uniform but is highly specific to certain regions and seasons. It also implies that climate adaptation, agricultural management, and water resource policies need to be tailored to regional and seasonal circumstances. These zone-specific and season-specific ENSO-rainfall relationships can improve forecast accuracy and enhance resilience to future hydroclimatic extremes.

Keywords: Climatic zones; ENSO; monsoon seasons; standardized precipitation index



Paper ID: NSALS '26-161 (Oral)

Spatiotemporal Investigation of Fragmented Mangrove Patches in Nayaru Lagoon, Sri Lanka using Sentinel-2 and Machine Learning Algorithms

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Mangrove ecosystems provide critical ecological services, including Carbon sequestration, coastal protection, and support for fisheries. Understanding their spatial and temporal dynamics is increasingly important for vulnerable island nations facing climate change and anthropogenic pressures. However, accurately detecting fragmented mangrove patches within heterogeneous vegetation landscapes remains technically challenging. An integrated random forest-based classification framework using Sentinel-2 multispectral imagery was developed to assess the spatiotemporal dynamics of fragmented mangrove patches in Nayaru lagoon, Sri Lanka, an ecologically significant coastal ecosystem. Sentinel-2 Level-2A surface reflectance images acquired throughout each year (January-December) from 2020 to 2024 were processed in Google Earth Engine web-based platform using cloud masking to generate cloud-free annual median composites. NDVI, NDMI, MNDWI, GCVI, SR, R35, R54, and SAVI were used as predictor variables in a random forest classification, and a per-band median reduction was applied to generate a single composite image. An unsupervised k-means clustering (25 spectral clusters) was first performed to identify spectrally distinct classes. Robust ground-truth surveys were conducted to capture heterogeneous mangrove compositions, and the Global Mangrove Watch (GMW) v4 dataset was used as baseline reference data. A random forest model trained with 500 ground-verified samples classified mangrove and non-mangrove areas, achieving >89% overall accuracy and a Kappa coefficient >0.77. Although annual maps were produced for 2020-2025, temporal analysis focused on 2020, 2022, and 2024 to minimize inter-annual variability. Mangrove extent increased from 148.93 ha (2020) to 151.40 ha (2022) and 157.10 ha (2024), representing a 13.26% increase, while 2025 (159.94 ha) represents the most recent mapped condition. This overall increase in mangrove may be attributable to a combination of successful protection and natural recovery due to a reduction of anthropogenic disturbances. The methodology successfully detected small, fragmented stands (<0.5 ha), providing spatial detail for this previously unmapped lagoon system. These findings demonstrate the effectiveness of integrating Sentinel-2 imagery with machine learning for monitoring fragmented mangrove ecosystems and providing critical baseline data for implementing well-planned conservation and restoration strategies to ensure long-term ecological resilience.

Keywords: Fragmented ecosystems; google earth engine; mangrove mapping; random forest model; sentinel-2



Paper ID: NSALS '26-172 (Oral)

Effect of Poultry Manure Feeding Rate on Black Soldier Fly (*Hermetia illucens*) Larvae Composting Efficiency

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Insect larvae, such as Black Soldier Fly Larvae (BSFL: *Hermetia illucens*), are currently being considered as an alternative protein source for livestock and aquaculture, while also serving as agents for managing organic waste. This research was conducted to determine the effect of poultry manure feeding BSFL composting efficiency. The experiment was conducted using a completely randomized design with three treatments and three replicates per treatment, in which BSFL were fed poultry manure at feeding rates of 200 mg/(larvae.day) (T1), 300 mg/(larvae.day) (T2), and 500 mg/(larvae.day) (T3) for a seven-day experimental feeding period, until the larvae reached the pre-pupal stage. All steps of this study were conducted at room temperature (27°C–30°C) and relative humidity (RH=65-75%). During the study, the body length and weight of 10 larvae from each replicate were recorded on 3rd and 6th day. Performance parameters, including Waste Reduction Index (WRI), Feed Conversion Rate (FCR), bioconversion rate, efficiency of conversion of digested feed, Substrate Reduction (SR), Average Body Weight (ABW), and Average Body Length (ABL) of the larvae were evaluated. All data were analyzed using one-way ANOVA followed by Tukey's test. Treatment 1 (T1; 200 mg/(larvae.day) recorded the highest WRI (9.44±0.05) and SR (66.11±0.31%), which were significantly higher ($P<0.05$) than those of T3 (500 mg/(larvae.day)). In contrast, larval growth performance was highest in Treatment 3, with significantly greater ABW (0.0727±0.0037 g) and ABL (1.50±0.02 cm) observed on day 6 ($P<0.05$). Feed conversion rate, bioconversion rate, and efficiency of conversion of digested feed did not differ significantly among treatments ($P>0.05$). Results indicated that the rate of feeding influence on the growth parameters, substrate reduction and waste conversation efficiency. Overall, it is indicated that lower feeding rates enhance poultry manure reduction efficiency, while higher feeding rates favor larval growth performance.

Keywords: Black soldier fly; feeding rate; poultry manure; waste reduction index



Paper ID: NSALS '26-211 (Oral)

Temporal Analysis of Vegetation Cover Changes in Palatupana Sand Dunes, Sri Lanka

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Coastal sand dunes are dynamic geomorphological features that serve as natural barriers against sea level rise and coastal erosion. These dunes are shaped by wind, wave action, and vegetation growth. Vegetation within sand dunes prevents erosion, stabilize dunes structures, supports biodiversity, and improves the soil quality. However, a thorough study of sand dune-associated vegetation in Sri Lanka has not been documented in the literature. To address this gap, this study focuses on the assessment of vegetation cover in the Palatupana sand dune area (6°14'52.8"N, 81°23'34.8"E) from 2016 to 2024. Nine Sentinel-2 Level-2A satellite images, one from January of each year between 2016 and 2024, were collected from the Copernicus Browser. January images were selected because cloud cover during this period is generally below 10%. The atmospheric correction was conducted for these images using the Sen2Cor algorithm. All images were geometrically corrected to the map projection of UTM zone 43N. The images were clipped to the study area boundary using a shapefile, which was created using Google Earth software. All the non-vegetated areas were masked to ensure a focused and accurate analysis of the vegetation variability within this study region. The Normalized Difference Vegetation Index (NDVI) raster was created using red and NIR bands. This layer was further reclassified as vegetation and non-vegetation classes. The stratified random sampling method was used for accuracy assessment. The results indicate that the NDVI-based classification effectively distinguished vegetated and non-vegetated areas, achieving an overall accuracy of 83.41%. The user's accuracy was 81% for the vegetation class and 85.85% for the non-vegetation class, while the producer's accuracy reached 85.26% for vegetation and 81.73% for non-vegetation. The classification yielded a Kappa coefficient of 0.67, indicating substantial agreement. The total vegetation area increased from 3.05×10^5 m² (39.54%) in 2016 to 3.09×10^5 m² (39.98%) in 2024. Vegetation cover trend from 2016 to 2024 indicated no statistically significant change using the Mann-Kendall trend test ($\tau=0.17$, $P>0.05$), Sen's slope analysis (475 units/year), and the 95% confidence interval (-4100 to 4500) included zero. Although inter-annual variability was observed, the overall trend indicated remarkable stability, demonstrating the ecosystem's resilience over time.

Keywords: NDVI; Palatupana sand dunes; sentinel-2; vegetation cover



Paper ID: NSALS '26-233 (Oral)

A Preliminary Study on Disposal Practices of Unwanted Pharmaceuticals at the Household Level in Sri Lanka: Implications for Aquatic Pollution

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Pharmaceuticals are essential for preventing, managing, and treating diseases in humans and animals. However, the improper disposal of unused or expired medicines has become an emerging environmental concern, posing risks to human health, aquatic ecosystems, and overall environmental quality. Understanding of pharmaceutical pollution in Sri Lanka remains limited, and there is still no national “drug-take-back” system for proper management of unwanted household medicines. This preliminary study aimed to investigate household disposal methods, public awareness of environmental impacts, and commonly used pharmaceuticals that may contribute to aquatic pollution in Sri Lanka, using an online questionnaire covering general information, medicines used, disposal practices, and attitudes and awareness. Data were collected (n=454 respondents) from all 25 administrative districts between June 28 and July 30, 2025. The survey revealed that 81.8% of households currently store unwanted medicines, mainly retained for future use if the same illness recurs (25.96%), being given excess medication (20.88%). Disposal frequency varied, with 38.30% discarding medicines soon after use, 20.33% once a year, and 15.60% only once in a few years. High-use pharmaceutical categories included painkillers such as Paracetamol (52.76%) and Aspirin (20.21%), allergy and respiratory drugs like Cetirizine (45.45%) and Salbutamol (14.31%), antibiotics including Amoxicillin (45.33%) and Augmentin (11.88%), and other medicines such as Omeprazole (43.04%) and Atorvastatin (75.36%). Disposal practices were largely unsafe: 43.87% discarded medicines in household garbage, 19.73% burned them, 10.67% buried them, and 5.60% disposed of the drainage, while only 2.27% returned medicines to pharmacies or healthcare facilities. Knowledge of proper disposal was low, with 73.05% never receiving guidance, and media (53.66%) being the main source among those informed. Awareness of pharmaceutical pollution was high, with 42.76% perceiving a large contribution to aquatic pollution and 79.91% acknowledging harm to aquatic organisms. Awareness of disposal methods was limited (50.35% slightly aware), yet 55.08% strongly agreed proper management is needed, 70.92% were highly likely to return medicines, and pharmacies (43.50%) and hospitals (34.04%) were preferred for collection bins. The respondents (93%) strongly expected future awareness initiatives. This study provides baseline data to guide improved household pharmaceutical management in Sri Lanka, aimed at mitigating aquatic environmental pollution from improper disposal.

Keywords: Emerging contaminants; environmental pollution; pharmaceutical pollution; unwanted medicines



Paper ID: NSALS '26-092 (Poster)

Evaluation of Physical Properties of Biochar Produced from Selected Organic Wastes at Different Pyrolysis Conditions

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The increasing piling up of agricultural residues in Sri Lanka causes severe environmental issues due to open burning and rampant disposal, leading to air contamination and nutrient loss. Biochar production through pyrolysis transforms these wastes into a stable, Carbon-rich material that enhances soil fertility, water retention, and long-term Carbon sequestration. However, biochar's functional properties depend on feedstock type and pyrolysis conditions like temperature and residence time, with limited local research in Sri Lanka examining these effects on key physical characteristics such as bulk density, porosity, water-holding capacity (WHC), particle density, and ash content. This study utilized a $2 \times 2 \times 2$ factorial completely randomized design, consisting of three replicates, to examine the yield and physical properties of biochar, which included bulk density, porosity, ash content, and WHC derived from *Gliricidia* wood and sawmill wood chips. The biochar was produced at two pyrolysis temperatures (400°C and 500°C) and subjected to two residence times (15 min and 30 min) in a muffle furnace with limited Oxygen. The research also assessed its impact on the growth of *Amaranthus viridis*. Biochar yield significantly ($P<0.05$) declined with higher temperature and residence time, from $33.21 \pm 1.00\%$ (wood chips, 400°C, 15 min) to $9.40 \pm 0.58\%$ (*Gliricidia* wood, 500°C, 30 min), due to intensified carbonization. Bulk density significantly ($P<0.05$) decreased from 0.37 ± 0.01 g/cm³ to 0.25 ± 0.01 g/cm³ while particle density significantly ($P<0.05$) rose from 1.21 ± 0.00 g/cm³ to 2.61 ± 0.01 g/cm³ with increasing temperature and residence time, indicating enhanced structural stability and Carbon condensation. Porosity and WHC improved substantially, with WHC significantly ($P<0.05$) rising from $215.32 \pm 2.38\%$ to $293.43 \pm 1.37\%$, due to better pore formation. Ash content significantly ($P<0.05$) increased from $1.60 \pm 0.06\%$ to $9.33 \pm 0.18\%$ with temperature, reflecting mineral enrichment. *Gliricidia* wood biochar at 500°C for 30 min exhibited optimal traits: high porosity, superior WHC, and low bulk density, ideal for soil amendment. In pot trials, biochar application boosted *A. viridis* growth over controls. The top performer, *Gliricidia* biochar (500°C, 30 min) yielded significantly ($P<0.05$) maximum mean stem height (72.73 cm) and leaf number (291.33). Overall, *Gliricidia sepium* biochar made at 500°C for 30 min had improved physical properties and usability in sustainable agriculture. Future studies should address long-term field performance and soil productivity impacts.

Keywords: *Amaranthus viridis*; biochar; pyrolysis; soil amendment



Paper ID: NSALS '26-135 (Poster)

Assessment of Microplastic Contamination and Distribution in Soil around a Selected Landfill Site in Galle, Southern Province, Sri Lanka

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Microplastics (MPs) are an emerging pollutant of global concern due to their persistence in the environment and their ability to translocate in different ecosystems through multiple pathways. Non-engineered landfills are major sources of MPs that can migrate into surrounding soil and pose long-term ecological and health risks. However, the role of soil layers in accumulation and distribution of MPs has received little attention in Sri Lanka. This study focuses on studying the concentration, distribution, and characteristics of MPs in surface soils positioned approximately 100 m from the Monroviawatta dumpsite in Rathgama, Galle, Sri Lanka. The soil samples were collected from two different surface layers (0-5 cm, and 5-10 cm) at five selected sampling locations. The collected soil samples were subjected to sieving, density separation, and organic digestion to effectively extract MPs. MPs were classified by shape, size, and color using stereomicroscopy, and selected particles' polymeric composition was confirmed via Fourier Transform Infrared (FTIR) spectroscopy. The results indicated that both soil layers: 0-5 cm, 5-10 cm were contaminated with MPs, with concentrations ranging from 80-180 particles/kg and 120-360 particles/kg respectively, showing a significant variation in MP accumulation in two soil layers ($P < 0.05$). Soil layer with 5-10 cm showed significantly higher MP concentrations than 0-5 cm layer. This downward movement of MP particles is likely facilitated by soil properties, leaching effects, surface losses, degradation trend, physical trapping and other environmental processes. The dominant size class of MPs were found to be tiny particles with < 1 mm (51.72%: 0-5 cm layer, 71.67%: 5-10 cm layer) while remaining particles were higher than 1 mm in size. Despite the soil layer, fibers are the dominant MP shape, accounting for approximately 93.26% followed by fragments (4.49%) and films (2.25%) of the total identified particles. Black MPs were the dominant fraction in the topsoil layer: 0-5 cm (41.38%), whereas blue MPs were abundant in the 5-10 cm layer (36.67%). FTIR results revealed that polypropylene and low-density polyethylene as the predominant polymers. These findings highlight those non-engineered landfills act as persistent and dynamic sources of soil contamination, emphasizing the urgent need for effective waste management and monitoring strategies.

Keywords: Microplastic; non-engineered landfill; surface layer; vertical migration



Paper ID: NSALS '26-184 (Poster)

Microplastic Pollution in Freshwater Systems along an Urban-suburban Gradient of Southern Sri Lanka

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Accumulation of Microplastics (MP) in freshwaters is a growing concern due to ecological and human health risks. Rivers act as conveyors of plastics into the ocean worldwide. The current study focused on fulfilling the knowledge gaps remaining MP concentrations in the freshwater environments of Sri Lanka. Accordingly, this study assessed the MP pollution in three selected freshwater bodies: Gin river (suburban), Kepu ela (suburban) and Moragoda ela (urban) in the southern Sri Lanka. The surface water samples were collected from selected sampling points using a neuston net (mesh size 300 μm) considering land use pattern through a pre-defined urban-suburban gradient. The samples were initially subjected to wet peroxide oxidation using 0.05 M Ferrous Sulfate solution and 30% Hydrogen Peroxide. After that, samples were treated with saturated NaCl for density separation and followed by subsequent filtration process to extract MP particles. The particles were enumerated and characterized in terms of size, shape, and color using a stereomicroscope. Density of MPs in Gin river, Kepu ela and Moragoda ela were 12 ± 2 particles/ m^2 , 15 ± 4 particles/ m^2 and 13 ± 7 particles/ m^2 respectively. Fiber-shaped MPs were highly abundant in all sites recording 100% in Kepu ela followed by 98% in Moragoda ela and 91% in Gin river. In terms of sizes, approximately 70% of particles in the Gin river were mostly below 1.0 mm with mainly black, blue and red colored MPs. In Kepu ela, approximately 75% of MP particles were below 1.5 mm and recorded diverse color categories (black, blue, red, green, purple and transparent). Similarly, approximately 80% of particles were below 1.5 mm with black, blue and red colored particles in Moragoda ela. Prevalence of fiber particles with multiple colors reveal that cumulative effect of point and non-point sources cause MP pollution in the surface waters. The findings indicate the baseline approach of MP pollution in the southern Sri Lankan urban-suburban freshwaters highlighting the importance of waste management in order to reduce MP pollution in the affected areas. As future implications, critical evaluation of the underlying factors on characteristic MP distribution in freshwater is suggested considering catchment area and climate variations.

Keywords: Fiber; freshwater; microplastics; southern Sri Lanka; urban-suburban gradient



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Paper ID: NSALS '26-006 (Oral)

Evaluation of Sensory and Physicochemical Changes in Tilapia Fish (*Oreochromis niloticus*) during Hot Smoking with Different Leaf Wraps

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Different preservation and processing techniques have been used to extend the shelf life of fish, among which smoking remains one of the oldest and most effective methods. Smoking enhances flavor, color, texture, and stability, while contributing to unique sensory characteristics. Botanical leaves used in smoking release phenolic compounds, essential oils, and antioxidants that influence flavor development, aroma, and oxidative stability of the smoked product. This study was conducted to evaluate the effects of different firewood and leaf combinations on the sensory and keeping quality of tilapia (*Oreochromis niloticus*) subjected to hot smoking and subsequent refrigerated storage. The experiment consisted of three treatments, each with three replicates. Fresh fillets of uniform thickness (1.5±0.2 cm) were salted at 1.5% (w/w) salt and hot-smoked at 80°C for two hrs and 15 min using two types of fire woods; mahogany (*Swietenia macrophylla*) and cinnamon (*Cinnamomum verum*) combined with six botanical leaves: (banana (*Musa paradisiaca*), betel (*Piper betle*), tea (*Camellia sinensis*), black pepper (*Piper nigrum*), lotus (*Nelumbo nucifera*), and "Kenda" (*Macaranga peltata*). Smoked samples were vacuum packed and stored at 4°C for seven days (final moisture content <25%). Sensory evaluation was conducted with 30 untrained panelists (age 21-25), and keeping quality was assessed based on pH, TBARS (lipid oxidation), DNPH (protein oxidation), antioxidant activity, peroxide, and iodine values. Gas chromatography mass spectrometry (GC-MS) analysis was performed to identify key flavor compounds in the best performing treatments. Results revealed significant differences among treatments in sensory attributes and oxidative stability during storage ($P<0.05$). The combination of cinnamon firewood combined and "Kenda" leaves produced the highest sensory scores and superior oxidative stability. GC-MS analysis identified desirable flavor compounds, such as maltol, furanones, phenol, and organic acids, contributing to sweet, caramel like, smoky, and acidic notes in the best treatment. All smoked samples remained within acceptable quality limits during the seven days of frozen storage ($P>0.05$). In conclusion, hot smoking using cinnamon firewood combined with "Kenda" leaves produced the most desirable smoked tilapia, offering improved sensory quality, oxidative stability, and a unique flavor profile. This combination demonstrates strong potential for developing value-added smoked fish products for both domestic and export markets.

Keywords: Firewood leaf combinations; GC-MS; hot smoking; sensory evaluation; tilapia



Paper ID: NSALS '26-095 (Oral)

Development of Mung Bean-based Vegan Ice Cream Fortified with Inulin as a Prebiotic

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Vegan ice creams are frozen desserts made entirely from plant-based ingredients without adding any animal originated ingredients. Prebiotics are type of specialized dietary fibers that act as a food for beneficial gut microbiota. The present study aimed to develop a prebiotic-rich vegan ice cream using mung bean (*Vigna radiata*) milk as a primary ingredient and to evaluate physicochemical, nutritional, microbial and sensory properties of the developed vegan ice cream. Four formulations of vegan ice creams were prepared with different levels of mung bean milk (74, 73, 71, 69%) and inulin (0, 1, 3, 5%) while keeping other ingredients constant. The prepared ice cream samples were stored at -21°C. Physical (hardness, adhesiveness, overrun, melting rate) and chemical properties (moisture, pH, total soluble solids, ash, fat, carbohydrate, radical scavenging activity, total phenolic content, total flavonoid content) of the four treatments were evaluated. Radical scavenging activity, total phenolic content, total flavonoid content and pH were evaluated weekly during 4 weeks of storage period. Microbial analysis (Aerobic Plate Count, *Salmonella*, and *Escherichia coli*) were done in 2nd and 4th week. The treatments were evaluated for sensory attributes (using 30 untrained panelists). The data were analyzed using a Completely Randomized Design. Result showed that, addition of 1 to 3% of inulin increased overrun of mung bean ice cream ($P<0.05$). However, incorporation of 5% inulin resulted in a significant reduction in overrun ($P<0.05$). Increase in inulin content has lowered the hardness of mung bean ice cream ($P<0.05$). Significant differences were found in four ice creams for color & appearance, aroma, taste, mouthfeel, and overall acceptability. However, texture differences were not statistically significant ($P<0.05$). Overall acceptability was significantly higher in the treatment formulated with 0% inulin compared to the other treatments ($P<0.05$). During the storage, pH of the ice cream was increased, and total phenol content, total flavonoid content and radical scavenging activity were remained relatively stable. In conclusion, mung bean milk-based vegan ice cream supplemented with inulin demonstrated desirable physicochemical and sensory qualities, demonstrating its potential as a nutritious plant-based prebiotic alternative to dairy ice cream.

Keywords: Inulin; mung bean; physicochemical; prebiotic; sensory; vegan ice cream



Paper ID: NSALS '26-119 (Oral)

Effect of Ultrasound and Enzyme Treatments on Anthocyanin Extraction from Butterfly Pea Flower (*Clitoria ternatea* L.) for Application as a Natural Food Colorant

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The extraction of anthocyanins from *Clitoria ternatea* L. flowers is limited by pigment instability under heat and oxidative stress during conventional hot water extraction, resulting in low yields and reduced bioactivity. Ultrasound Assisted Extraction (UAE) and Enzyme Assisted Extraction (EAE) are non-thermal alternatives that enhance pigment release through cavitation and enzymatic hydrolysis. This study compared conventional hot water extraction with UAE and combines Enzyme Ultrasound Assisted Extraction (EUAE) for anthocyanin recovery from butterfly pea flower. Fresh petals were processed under standardized conditions (5 g petals were blended with 100 mL distilled water (1:20 w/v)), with UAE conducted at 40°C and 50°C for 15 and 30 min, and EUAE performed with cellulase, pectinase, and mannanase mixtures at 0.25% and 0.5%, and samples were incubated at 40°C for 30 min. Enzyme-treated samples were further subjected to UAE at the selected optimal condition (40°C for 30 min). Extracts were analyzed for total monomeric anthocyanins, total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity using the ferric reducing antioxidant power (FRAP) assay. Under these conditions, ultrasound-assisted extraction resulted in the highest anthocyanin content [13.80±0.12 mg cyanidin-3-O-glucoside equivalents (CGE)/L] at 40°C for 30 min, corresponding to an 18% increase compared with conventional hot water extraction (11.72±0.59 mg CGE/L). TPC was also maximized under UAE [155.86±1.55 mg gallic acid equivalent (GAE)/L], a 25% improvement over hot water extraction (124.60±5.22 mg GAE/L). TFC showed no significant difference among treatments [50.44-58.98 mg of quercetin equivalents (QE)/L]. Antioxidant capacity peaked under UAE, with FRAP values of 318.38±10.62 mg Fe²⁺/L at 50°C for 30 min, a 33% increase compared with hot water extraction. EUAE, however, produced lower anthocyanin and FRAP values, suggesting that prolonged enzyme incubation led to oxidative degradation. Overall, the UAE was identified as the most effective, green, and scalable method for maximizing anthocyanin and phenolic recovery from *C. ternatea* L. petals. Future studies should optimize enzyme-ultrasound combinations and explore stabilization strategies to ensure pigment stability in food systems.

Keywords: Anthocyanins; antioxidant activity; butterfly pea; enzyme assisted extraction; ultrasound assisted extraction



Paper ID: NSALS '26-120 (Oral)

Characterization of Modified Taro (*Colocasia esculenta*) Starch by Pre-gelatinization, Acid, and Dextrinization Processes

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Taro (*Colocasia esculenta*) is a rich source of starch; however, its native form exhibits poor solubility, limited stability, and restricted industrial functionality. Modification techniques, including pre-gelatinization, acid treatment, and dextrinization, can be applied to starch. These processes enhance its key physicochemical and functional properties, subsequently broadening its potential applications. This study aimed to modify taro starch using these techniques and characterize the resulting products to assess their suitability for food and industrial uses. Native starch was extracted from fresh taro tubers and modified through pre-gelatinization, acid hydrolysis, and dextrinization. Functional and physicochemical properties were analyzed using standard methods and ANOVA ($P < 0.05$). The recovery yields of modified starches ranged between 70.37-85.24%, comparable to the values reported for the other root starches. The modifications significantly altered functional properties. Swelling power nearly doubled in acid-modified starch (26.01%) compared to native starch (14.34%), while viscosity increased from 5.97 ± 0.05 mm²/s in native starch to 11.3 ± 0.01 mm²/s in dextrinized starch, indicating enhanced thickening potential. Water absorption capacity improved slightly after pre-gelatinization (2.11 ± 0.03 g/g) compared to native starch (1.83 ± 0.01 g/g). In contrast, oil absorption showed a marginal reduction (2.11 ± 0.05 g/g to 1.97 ± 0.00 g/g) following acid and dextrinization treatments. Solubility showed minor variation, ranging from $12.33 \pm 1.15\%$ to $14.67 \pm 0.58\%$, relative to $15.33 \pm 8.5\%$ in the native form. Paste clarity differed significantly, with acid-modified starch recording the highest value ($1.43 \pm 0.01\%$) compared to native starch ($1.14 \pm 0.01\%$), while pre-gelatinized starch exhibited a reduction ($0.46 \pm 0.00\%$). Overall, the modifications effectively addressed the limitations of native taro starch by improving its hydration, viscosity, and optical properties. Among the treatments, acid and dextrinization processes demonstrated the most promising enhancements, particularly in viscosity and clarity. These improvements suggest that modified taro starch can serve as a functional ingredient in food formulations that require enhanced viscosity, stability, and transparency, such as soups, sauces, coatings, and biodegradable films.

Keywords: Acid treatment; dextrinization; pre-gelatinization; starch modification; taro starch



Paper ID: NSALS '26-124 (Oral)

Comparative Analysis of Cooking Induced Changes in Nutritional, Physicochemical, and Sensory Properties of Two Sri Lankan Sweet Potato (*Ipomoea batatas* L.) Varieties

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Sweet potato (*Ipomoea batatas* L.) is valued for its nutritional quality, affordability, and contribution to food security. The study aims to evaluate the effects of boiling, baking, and frying on the nutritional composition, physicochemical properties, and sensory attributes of two Sri Lankan sweet potato varieties, Wariyapola Red (W) and Gannoruwa White (G), which have received limited research attention. Fresh tubers were subjected to boiling (100°C, 15 min), baking (180°C, 45-50 min, covered), and frying in coconut oil (180°C, 3-5 min). Moisture, ash, crude fat, and crude fiber contents were analyzed using standard AOAC (2000) methods: oven drying, incineration, Soxhlet extraction, and acid-alkali digestion, respectively. Instrumental color and texture analyses were performed to assess physicochemical changes, while sensory attributes were evaluated by 40 untrained panelists using a 7-point hedonic test. Boiling reduced moisture content (W: 2.40±0.71%; G: 2.27±1.29%) compared to raw samples (W: 2.99±0.01%; G: 3.78±0.38%), whereas baking retained the highest moisture levels (W: 4.55±3.85%; G: 4.44±2.83%). Ash content declined after boiling (W: 1.53±0.75%; G: 2.12±0.30%), while baking retained high mineral levels (W: 1.80±0.20%; G: 2.73±0.57%). Fried samples showed the highest crude fat content (W: 18.46±3.42%; G: 21.07±0.34%), whereas crude fiber remained comparatively stable during baking (W: 4.33±2.02%; G: 4.33±2.84%). While both mineral levels and crude fat showed significant differences ($P < 0.05$), moisture levels and crude fiber showed no significant differences ($P > 0.05$). While boiling produced softer textures, baking retained firmness with a golden color, and frying developed crispy exteriors with darker tones in the sweet potato. Sensory results indicated that fried samples had the highest overall acceptability followed by baked and boiled samples, reflecting consumer preference for crispness and flavor despite their higher fat content. In conclusion, baking provided the best balance between nutrient retention, texture, and color, while frying enhanced sensory appeal but reduced nutritional quality. Gannoruwa White consistently showed higher ash and fiber contents, indicating varietal resilience and processing potential. Thus, baking is recommended as the best overall method.

Keywords: Cooking methods; *Ipomoea batatas*; nutritional composition; physicochemical properties; sensory properties



Paper ID: NSALS '26-134 (Oral)

Network Pharmacology-based Elucidation of the Protective Mechanisms of the *Flacourtia inermis* Roxb. against Oxidative Stress

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Oxidative stress contributes to the pathogenesis of major non-communicable diseases, including cancer, diabetes, cardiovascular disorders, and neurodegeneration. *Flacourtia inermis* Roxb. commonly known as batoko plum and lovi-lovi, is an underutilized tropical fruit available in Sri Lanka and Southeast Asia. Though it is rich in polyphenols and flavonoids, few studies have focused on its antioxidant effects and related mechanisms. This study aimed to predict the molecular targets of *F. inermis* in mitigating oxidative stress using network pharmacology. Fruit extracts were prepared using sonication-assisted extraction with 70% methanol (1:10 w/v), followed by centrifugation, concentration, and freeze-drying. The extracts exhibited moderate antioxidant capacity, as evaluated using Total Phenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP), and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. The TPC was 32.23±8.12 mg GAE/g, the FRAP value was 176.27±5.61 µmol Fe²⁺/g, indicating moderate ferric reducing power, and the DPPH radical scavenging activity showed an IC₅₀ of 992.4±47.9 µg/mL, reflecting moderate free radical scavenging capacity compared to ascorbic acid (IC₅₀=10.9±0.3 µg/mL). Computational analyses using the Swiss Target Prediction (confidence score ≥0.5) and STITCH (confidence score ≥0.7) databases predicted 155 protein targets for the 17 identified compounds comprising polyphenolic compounds and anthocyanins. Relevant oxidative stress related genes were identified from the GeneCards and OMIM databases. A total of sixty seven significant targets associated with oxidative stress pathways were identified. Protein-protein interaction networks were constructed using the STRING database, highlighting 10 core hub targets based on Maximal Clique Centrality. The core hub genes were *AKT1*, *IL6*, *JUN*, *STAT3*, *TNF*, *NFKB1*, *MMP9*, *CTNBN1*, *IL1B*, and *HIF1A*. Among these, key oxidative stress regulators, including *NFKB1* (inflammatory response), *HIF1A* (hypoxic adaptation), and *STAT3* (redox signaling), were identified as more related nodes. Gene Ontology (GO) and Kyoto Encyclopedia of Genes and Genomes (KEGG) were analyzed for significantly involved targets ($P < 0.05$). Enrichment analysis indicated involvement of these targets in oxidative stress response, apoptosis, VEGF signaling, AGE-RAGE signaling, and HIF-1 pathways ($P < 0.05$). These findings provide mechanistic insights into the multi-target antioxidant activity of *F. inermis* and highlight its potential as a therapeutic resource. However, all predictions require validation through molecular docking, *in-vitro*, and *in-vivo* studies.

Keywords: *Flacourtia inermis*; gene ontology; KEGG pathway; network pharmacology; oxidative stress



Paper ID: NSALS '26-137 (Oral)

Evaluation of Physicochemical, Sensory, and Nutritional Properties of Gluten-free Instant Noodles Formulated from Jackfruit Seed Flour and Purple Yam Flour

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Instant noodles are among the most popular convenience foods worldwide, but conventional formulations, which are primarily made with refined wheat flour, are often criticized for their high glycemic index, low fiber content, and gluten, making them unsuitable for individuals with gluten related disorders. In Sri Lanka, jackfruit (*Artocarpus heterophyllus*) seeds and purple yam (*Dioscorea alata*) are abundant yet underutilized, contributing to substantial postharvest losses. Both are rich in starch, dietary fiber, minerals, and bioactive compounds, making them promising alternatives for the development of gluten-free food products. This study aimed to formulate gluten-free instant noodles using jackfruit seed flour (JSF) and purple yam flour (PYF) in varying ratios (100:0, 75:25, 50:50, 25:75, and 0:100), followed by optimization at different xanthan gum levels (0.5-2%). The flours were evaluated for functional properties, while the noodles were assessed for physicochemical characteristics, proximate composition, cooking quality, microbial safety, and sensory acceptability. Statistical analysis was performed to identify the most suitable formulation. The results indicated that noodle formulation with 75% JSF and 25% PYF, supplemented with 0.5% xanthan gum, exhibited superior performance across multiple quality parameters. This formulation achieved low moisture content (7.50±0.02%), reduced water activity (0.60±0.44_{a_w}), near-neutral pH (5.80±0.03), and an attractive reddish-yellow appearance due to the natural anthocyanins of PYF. Proximate analysis revealed higher ash (6.60±0.00%) and crude fiber (3.34±0.57%) contents, along with lower fat (2.34±0.33%) and moisture (7.56±0.46%) levels, indicating enhanced nutritional quality. Cooking tests showed favorable outcomes, including a high cooking yield (209.33±1.85%), acceptable cooking loss (7.00±0.63%), and good water absorption capacity (109.03±1.85%). Sensory evaluation confirmed that 0.5% xanthan gum significantly enhanced texture, flavor, and overall acceptability (score 6.8/9), while microbial analysis after seven days of preparation indicated a low total plate count (1.9×10³ CFU/mL) and absence of yeast and mold, confirming product safety. In conclusion, jackfruit seed and purple yam flours are promising ingredients for the formulation of nutritious, gluten-free instant noodles, offering a sustainable approach to promote innovative food.

Keywords: Gluten-free; instant noodles; jackfruit seed flour; purple yam flour; xanthan gum



Paper ID: NSALS '26-142 (Oral)

Effect of Pectin on 3D Printability and Structural Properties of Pre-gelatinized Potato Starch Gel

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3D food printing is gaining attention as a platform for designing customized foods. The success of this technology relies on the development of stable and printable inks. Pre-gelatinized potato starch is a promising base material for developing a ready-to-print ink due to its favorable gel properties and its ability to dissolve in cold water. As the printability of starch-based inks is limited, hydrocolloids such as pectin can be incorporated to enhance the printing performance and the structural stability of potato starch gel. This study investigates the combined effect of varying pectin concentrations (1, 2, and 3%) and starch concentrations (10, 12.5, and 15%) on the 3D printability of pre-gelatinized potato starch inks. A complex structure was first designed in Computer-Aided Design (CAD) software. The structure was then printed using ink formulations prepared from all starch and pectin combinations. The printing fidelity of the structure was calculated from the top surface area using ImageJ software. The pre-gelatinized potato starch powder samples were further analyzed using X-ray diffraction and light microscopy, along with a control starch sample for each starch level without pectin. The highest printing fidelity was observed in the ink containing 12.5% starch and 2% pectin. The effects of both starch ($P < 0.05$) and pectin ($P < 0.05$) on printing fidelity were statistically significant. Their combined effect also had a significant influence ($P < 0.05$) on printing fidelity. Microscopy observations indicated a reduction in granule size of potato starch with increasing pectin levels, while the X-ray diffraction results showed an increase in the crystalline nature of the starch with the addition of pectin. This study suggests that pectin plays a major role in controlling the gelatinization extent of pre-gelatinized potato starch. Furthermore, it is evident that, apart from the individual effects of starch and pectin, their combined interaction also has a significant impact on the printability of the ink. Understanding these pectin-starch interactions and their contribution to the structural stability of the 3D printed food structures is important for developing better performing 3D food printing inks.

Keywords: 3D food printing; pectin; potato starch; printing fidelity; x-ray diffraction



Paper ID: NSALS '26-165 (Oral)

Effects of Churning Temperature and Working Time on the Composition of Salted Butter

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Butter is a widely consumed and highly concentrated dairy product made from milk fat, including 80% minimum fat content, 16% maximum moisture content and 2% salt content. Butter quality is influenced by processing factors including the fat content of cream, filling level of churners and the duration of churning and working, the process of mixing and kneading of butter to evenly distribute moisture and salt. This study investigated the effects of different working times on moisture content, fat content and salt content in salted butter, and identify the optimal time-temperature combination for achieving standard composition of salted butter. A factorial experiment was conducted with two churning temperatures (8 and 10°C) and three working times (0, 10, and 20 min), with three replicates each. Butter was produced from pasteurized cream (38% fat) in 450 L churners. After the churning, washing and salting, butter underwent working for specified times. Butter samples were collected, and moisture content, fat content and salt content were analyzed, and Texture Profile Analysis (TPA) was conducted. The results revealed that working time significantly affected butter composition ($P < 0.05$), while churning temperature had no significant effect ($P > 0.05$). There was no significant interaction between factors ($P > 0.05$). Moisture content of the cream decreased with increasing working times, with samples churned for 20 min meets the $\leq 16\%$ moisture standard. 0 min working samples resulted in uneven moisture distribution, while 10 min working samples showed intermediate results. TPA results indicated significant differences ($P < 0.05$) across treatments, with hardness, adhesiveness and springiness decreasing from 0 to 20 min of working, whereas cohesiveness showed no significant difference ($P > 0.05$). These findings demonstrate that 20 min of working optimizes salted butter composition regardless of churning temperature (8-10°C), ensuring compliance with regulatory standards while improving texture uniformity. It is recommended that implement at least 20 min working duration to ensure regulatory compliance regarding composition of salted butter.

Keywords: Butter composition; churning temperature; moisture content; salted butter; texture profile analysis; working time



Paper ID: NSALS '26-171 (Oral)

Development of a Synbiotic Fish Spread using Indian Mackerel (*Rastrelliger kanagurta*) with *Streptococcus thermophilus* and Inulin Oleogel

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The increasing consumer preference for functional food has enhanced the exploration of novel probiotic products beyond conventional dairy-based matrices. Fish, a rich source of high quality protein, polyunsaturated fatty acids, vitamins, and minerals, remains an underutilized substrate for probiotic food development despite its well-established nutritional benefits. Although Sri Lanka is rich in fish resources, there is a lack of scientific data and product development on fish-based synbiotic and probiotic foods. Therefore, this study aimed to develop a synbiotic fish spread using Indian mackerel (*Rastrelliger kanagurta*) enriched with *Streptococcus thermophilus* and inulin oleogel, and to evaluate its probiotic viability, nutritional composition, shelf-life, and sensory quality. Fresh mackerel were cleaned, filleted, autoclaved, and macerated, while inulin oleogel was prepared separately by continuous stirring of inulin, water, coconut oil, and soy lecithin at 85°C for 40 min. Four formulations of fish spread were prepared by mixing fish paste with varying levels of inulin oleogel: 0 (control), 2, 3, and 5%. The prepared fish spread was incubated at 37°C for 24-48 hrs to achieve the desired growth of *Streptococcus thermophilus*. Proximate composition, texture profile, sensory attributes, storage stability, probiotic viability, microbiological quality, pH, TBARS (Thiobarbituric Acid Reactive Substances), and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay were carried out to determine nutritional and functional properties during the storage (4°C). Results revealed that the spread containing 2% inulin oleogel achieved the highest consumer acceptability, particularly in terms of texture, aroma, and overall palatability ($P < 0.05$). Proximate analysis indicated significant differences among formulations, with the 5% inulin oleogel sample showing the highest protein and ash content. Texture analysis demonstrated improved hardness and adhesiveness in the 2% inulin oleogel treatment, while microbial assessments confirmed acceptable viability of *Streptococcus thermophilus* (10^7 CFU/mL). The DPPH assay confirmed significant antioxidant activity and TBARS assay indicated progressive lipid oxidation across treatments; yet, values remained within acceptable limits throughout 28 days of refrigerated storage. In conclusion, the incorporation of inulin oleogel and *Streptococcus thermophilus* into a fish substrate successfully produced a nutritionally enhanced and sensory acceptable novel synbiotic fish spread.

Keywords: Indian mackerel; oleogel; *Streptococcus thermophilus*; synbiotic



Paper ID: NSALS '26-174 (Oral)

Development and Characterization of Packaging Films from Seaweed (*Kappaphycus alvarezii*) Carrageenan and Taro Yam (*Colocasia esculenta*) Starch

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Excessive use of plastics, particularly in packaging, has led to significant environmental challenges. Biodegradable biopolymers derived from renewable resources present a promising alternative for mitigating plastic pollution. Taro yam (*Colocasia esculenta*) starch is an emerging alternative due to its renewability and film forming ability, however, its brittleness and poor water resistance limit practical applications. Carrageenan is a hydrocolloid extracted from red seaweed (*Kappaphycus alvarezii*) which can potentially improve the structural and functional properties of starch based films. In this study, carrageenan and taro yam starch were used to develop films using the solvent casting method. Varying carrageenan ratios (S1: 0.00 g, SC1: 0.50 g, SC2: 1.00 g, SC3: 1.50 g, SC4: 2.00 g) were used, while maintaining a constant starch (3.00 g) and glycerol content (1.50 g), and five distinct formulations were created. Films were evaluated for their tensile strength, thickness, moisture content, and film solubility. The molecular structure was characterized using Fourier Transform Infrared (FTIR) spectroscopy. The suitability of the films for active packaging applications was evaluated through the assessment of their antioxidant activity using the DPPH assay. The thickness of SC4 film (0.147±0.004 mm) was significantly higher ($P<0.05$) than other samples. The tensile strength of SC3 film (8.060±0.456 MPa) was significantly higher than other samples. The water solubility of the films was decreased from S1 (42.346±5.652%) to SC4 (29.096±4.885%), while the moisture content was reduced from S1 (29.174±5.174%) to SC4 (17.296±4.626%). The IC₅₀ values of the films were decreased from 171.049±4.843 µg/mL (S1 film) to 26.776±4.778 µg/mL at the highest carrageenan concentration (SC4 film), indicating stronger radical scavenging ability. FTIR analysis revealed progressive shifts in the O–H and sulfate ester peaks across the five film formulations. Compared to the other films, the SC4 film showed the strongest O–H absorption, suggesting improved hydrogen bonding. The potential of the developed films as food packaging was proven, showing that vegetable salads could be successfully wrapped while maintaining their integrity. These results highlight that starch-carrageenan composite films are promising environmentally friendly alternatives for sustainable packaging.

Key words: Carrageenan; DPPH assay; packaging film; sustainable packaging; taro yam starch



Paper ID: NSALS '26-180 (Oral)

Development of a Composite Film using Arrowroot (*Maranta arundinacea*) Starch and Evaluation of Moisture Barrier Properties in Ice Cream Cones

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Edible films and coatings play a critical role in controlling moisture migration in composite frozen desserts and foods composed of components with differing water activities. Since most foods inherently contain high moisture levels, uncontrolled moisture transfer can lead to texture deterioration, phase separation, and overall quality loss during frozen storage. Therefore, this study aimed to formulate edible films using arrowroot (*Maranta arundinacea*) starch at different concentrations, in combination with sunflower oil, glycerin, Tween 80, citric acid, and soy lecithin, and to evaluate their physicochemical and moisture barrier properties. The films were produced by the solvent casting method. Arrowroot starch solutions (2, 3, and 4% w/v) were gelatinized at 85°C and then mixed with appropriate ingredients for edible film formation. All measurements were performed in triplicate. Scanning electron microscopy revealed smooth surfaces without cracks and pores. The films were classified as transparent, colorless, flexible films (except at 2% starch). The water solubility ranged from 18.75-22.07%, considered low with no significant difference ($P>0.05$) across concentrations. Increasing starch concentration significantly ($P<0.05$) increased the thickness and viscosity of the edible coatings, while resulting in lower pH, reduced transparency, and decreased water vapor transmission rate, although these latter changes were not statistically significant ($P>0.05$). Application of edible coating on ice cream cone composites showed that moisture resistance was improved by 45.78, 46.41, and 55.78% for the 2, 3, and 4% starch films, respectively, within 20 min. Based on these findings, arrowroot starch based edible films demonstrated effective moisture barrier performance when applied as coatings for ice cream cones. Among the formulations tested, the 4% starch coating exhibited the highest barrier efficiency, indicating its potential as a sustainable, edible coating for controlling moisture migration and preserving cone crispness during ice cream storage.

Keywords: Arrowroot starch; biopolymers; moisture barrier; physicochemical properties; solvent casting



Paper ID: NSALS '26-182 (Oral)

Effect of Agar-Gelatin Combinations on Color Stability and Physicochemical Properties of Jelly at Refrigerated Storage

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Color stability and textural consistency play an important role in maintaining the sensory identity and consumer acceptability of jelly-based desserts. The current study evaluated the effect of agar (0.93, 0.95, and 0.97%) and gelatin (0.39, 0.40, and 0.41%) combinations on color stability (ΔE), pH, total soluble solids, syneresis, and texture profile (hardness, cohesiveness, springiness, and chewiness) of jelly during 21 days of refrigerated storage (4°C). The stabilizer concentrations were selected based on the preliminary trials. Nine formulations were prepared in a 3 × 3 factorial design and analyzed using standard methods. Color stability was determined using a colorimeter, while pH, texture, and syneresis were determined according to standard analytical procedures. Sensory analysis was conducted with 30 untrained panelists using a 7-point hedonic scale to assess appearance, color, aroma, texture, taste, and overall acceptability. Data were analyzed using one-way ANOVA at 95% confidence level. The findings indicated that stabilizer type and concentration significantly affected all physicochemical parameters ($P < 0.05$). The 0.93% agar-0.40% gelatin combination exhibited optimal color stability ($\Delta E = 3.31 \pm 0.8$) minimizing visible color changes. The pH declined from 7.10 ± 0.01 to 4.43 ± 0.02 over 21 days, with higher agar levels maintaining better stability. Syneresis was lowest in balanced agar-gelatin ratios (0.93-0.40% and 0.95-0.39%), preventing water separation. Increased agar concentration enhanced hardness (a maximum of 498.83 ± 5.73 g) and chewiness, while higher gelatin levels produced softer and more elastic textures. Overall, optimal agar-gelatin ratios (0.93-0.40% and 0.95-0.39%) enhance color retention, pH stability, syneresis control, and sensory quality, providing industry relevant formulations for stable, high-quality refrigerated jelly products.

Keywords: Agar; color stability; gelatin; jelly; physicochemical properties; refrigerated storage



Paper ID: NSALS '26-187 (Oral)

Comparative Evaluation of ISO 14502-2:2005(E) and ISO 10727:2002(E) Methods for Caffeine Analysis in Black Tea: Implications for Quality Control and Value Addition in the Tea Industry

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Caffeine, a principal bioactive alkaloid in *Camellia sinensis*, is crucial in maintaining product consistency in the global tea industry. While moderate caffeine consumption is associated with several health benefits, excessive caffeine intake may cause adverse health effects, highlighting the importance of accurate caffeine quantification for quality assurance, product standardization, quality control and consumer safety. Caffeine determination is typically performed using two different protocols: ISO 14502-2:2005(E), a method primarily developed for catechin analysis and secondarily for caffeine, and ISO 10727:2002(E), a method specifically designed for caffeine analysis. Although ISO 10727:2002(E) is the specific method for caffeine quantification, ISO 14502-2:2005(E) is widely used for routine laboratory analysis in the local context, creating uncertainty in selecting the most appropriate method for black tea analysis. Therefore, this study presents a comparative evaluation of these two ISO methods for caffeine quantification, using thirty caffeinated and thirty decaffeinated black tea samples, collected through convenience sampling and evaluated their associated cost and time requirements. The caffeine was quantified by high-performance liquid chromatography (HPLC) following methanolic extraction in ISO 14502-2:2005(E) and reflux extraction in ISO 10727:2002(E). The reflux extraction in ISO 10727:2002(E) likely enhances caffeine solubilization, contributing to higher caffeine recovery compared to the methanolic extraction used in ISO 14502-2:2005(E). Caffeine contents obtained using ISO 10727:2002(E) and ISO 14502-2:2005(E) were statistically compared using R software, applying paired t-test for caffeinated tea and the Wilcoxon signed-rank test for decaffeinated tea. Significant differences were observed between the two analytical methods for both caffeinated and decaffeinated teas ($P < 0.05$). ISO 10727:2002(E) yielded a higher mean caffeine content for caffeinated teas (2.81 ± 0.34 mg/g) compared to ISO 14502-2:2005(E) (2.57 ± 0.32 mg/g). The mean caffeine contents of decaffeinated tea showed comparable values between ISO 10727:2002(E) (0.61 ± 0.29 mg/g) and ISO 14502-2:2005(E) (0.60 ± 0.29 mg/g). Although both methods consistently quantified caffeine, ISO 10727:2002(E) yielded slightly higher values with more variability. ISO 14502-2:2005(E) required less processing time, whereas ISO 10727:2002(E) was slower but more cost-effective. ISO 14502-2:2005(E) suits multi-compound analysis, while ISO 10727:2002(E) is preferable for caffeine-specific determinations.

Keywords: Black tea; caffeine analysis; *Camellia sinensis*; HPLC; ISO 10727; ISO 14502-2



Paper ID: NSALS '26-228 (Oral)

Formulation of Sustainable Gluten-free Food Ink using Jackfruit Seed Flour for Extrusion Based 3D Food Printing

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The rising demand for gluten-free foods driven by celiac disease and consumer preferences, presents challenges for 3D food printing. Conventional wheat-based doughs rely on gluten's viscoelastic network for structure and printability, while gluten-free alternatives often lack the binding capacity and structural integrity required for extrusion-based printing. Jackfruit seed flour (JSF), a nutrient-rich byproduct of jackfruit processing, offers a sustainable raw material for developing gluten-free food inks. This study focused on the formulation and optimization of JSF-based inks for 3D printing applications. Jackfruit seeds were processed into flour and characterized for functional properties namely, water absorption capacity, oil holding capacity, swelling index, and bulk density, to identify its suitability as structural and binding agents. Four formulations with varying JSF to milk ratios [F1 (16:22), F2 (18:20), F3 (20:18), and F4 (22:16), w/w] were prepared and evaluated for printing fidelity and extrusion behavior. Data were analyzed using one way ANOVA to determine significant differences among formulations. The formulation containing 20% JSF and 18% milk (F3) exhibited the optimal extrusion and minimal shape deformation. Quantitative analysis showed that F3 achieved the significantly highest ($P < 0.05$) top surface printing fidelity at $98.17 \pm 0.18\%$ compared to other treatments. Optimal printing parameters were identified as 1.0 mm layer height, 25°C printing temperature, and 5 mm/s extrusion speed. Under these conditions, the JSF based ink successfully produced complex biscuit designs with clear geometric definition and uniform surface texture. JSF based inks facilitated the printing of complex biscuit designs with high surface fidelity, demonstrating their suitability for 3D food printing. JSF can be effectively used in 3D printable doughs, adding value to an agricultural by-product while enabling customizable gluten-free baked foods. This study presents a framework for developing sustainable, structurally stable food inks that can be used for extrusion based 3D food printing.

Keywords: Agricultural by-products; extrusion-based 3D food printing; gluten-free; jackfruit seed flour; printing fidelity; sustainable food ink



Paper ID: NSALS '26-230 (Oral)

Effects of Soaking on Structural Properties and Hydrolysability of Velvet Bean (*Mucuna pruriens*) Proteins

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Velvet bean (*Mucuna pruriens*) is a protein rich underutilized legume with potential food applications. However, limited studies have addressed how pre-processing treatments such as soaking influence its protein structure and digestibility. The present study investigated the effects of soaking on structural properties and hydrolysability of velvet bean (*Mucuna pruriens*) proteins. Two soaking media, which is bottled water and citric acid solution, were applied at 4 different time durations like 4, 9, 12, and 24 hrs to examine their influence on protein secondary structure, enzymatic digestibility and protein yield. Fourier Transform Infrared spectroscopy (FTIR) revealed that soaking in citric acid induced significant structural alterations, including increased β -sheet content and protein denaturation, facilitating enhanced enzymatic accessibility. SDS-PAGE supported these findings by demonstrating protein size distribution changes indicative of partial hydrolysis, particularly at 9 to 12 hrs of citric acid soaking. Ortho-phthaldialdehyde (OPA) assays showed that amino acid release during enzymatic digestion was highest in citric acid-treated samples, peaking at 9 hrs. OPA assays showed that amino acid release during enzymatic digestion was highest in citric acid-treated samples, peaking at 9 hrs. Even after extended soaking, water soaking preserved native like α -helical structures with just slight alterations, which led to decreased digestibility and amino acid release. The best conditions for increasing the hydrolysability of velvet bean protein were found to be 9 and 12 hrs of citric acid soaking, which offers a promising way to increase the nutritional and functional qualities of this underutilized legume for food applications.

Keywords: Digestibility; FTIR; protein denaturation; soaking; velvet bean



Paper ID: NSALS '26-010 (Poster)

Development of Ready-to-Serve Soup using Low Grade Fresh Water Fish *Labeo rohita*

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Fish and fish-based products are widely consumed in the world and it is a good source of high-quality protein and essential nutrients. Although fresh water fish production has increased in recent years due to undesirable muddy flavor, hinders the consumer acceptability. Hence, this study was aim to develop a ready to serve soup using Rohu (*Labeo rohita*) that reduces the undesirable flavor and enhances the consumer acceptance. Rohu fish powder was prepared using thermal processing (150°C for 4 hours) and the fish soup recipe was developed assessing corn flour, turmeric powder, skim milk powder and spices. Sensory evaluation was conducted with 30 untrained panelists (aged 21-25 years) using a 7-point hedonic scale to determine final best recipe. Fish soup was hydrolyzed using kiwifruits (Actinidin) and pineapple (Bromalin) extracts a concentration of 0.1-0.5% (w/v). SDS-PAGE and o-phthaldialdehyde (OPA) method were used to determine the best hydrolysis time and concentration combination. Final sensory evaluation revealed that the non-hydrolyzed soup formulation was the best. Hydrolyzed and non-hydrolyzed fish soup powders were subjected to further analyses, keeping quality tests, pH, DPPH assay, DNPH assay, total plate count (TPC) and TBARS assay, on a weekly interval for 35 days. The study exhibited that there was no significant difference in pH and protein oxidation values in all treatments up to 35 days ($P>0.05$). Further, a significant difference was not observed in the lipid oxidation value across treatments during the storage period ($P>0.05$). The non-hydrolyzed fish soup powder exhibited the highest DPPH values ($55.26\pm 1.51\%$). Total plate count showed a significant difference among the three treatments, with the non-hydrolyzed powder showing the TPC value (8.05 ± 0.02 CFU/mL) after day 35, suggesting potentially lower microbial activity. Proximate analysis of the final soup exhibited crude fat ($10.15\pm 0.04\%$), moisture content ($5.34\pm 0.65\%$), and ash content ($5.64\pm 0.03\%$). This study developed a ready-to-serve soup powder using Rohu to mitigate the undesirable muddy flavor while maintaining sensory quality, antioxidant potential, and consumer acceptance.

Keywords: Hydrolyzed; kiwi fruit extract; pineapple extracts; Rohu fish; soup powder



Paper ID: NSALS '26-021 (Poster)

Development and Quality Evaluation of Cookies Partially Substituted with Date (*Phoenix dactylifera* L.) Seed Powder as a Functional Ingredient

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Date seeds (DS), a common byproduct of the date fruit industry, are rich in dietary fiber, protein, minerals, and antioxidants. Despite this rich nutritional profile, they remain significantly underutilized. Therefore, the aim of this study was to utilize this potential for the innovative development and quality evaluation of functional cookies by substituting wheat flour (WF) with date seed powder (DSP) to create a healthier and sustainable bakery product. DS were isolated from fully ripened date fruits sourced from the Badulla local market. The seeds were washed, oven-dried at 50°C for 48 hours, and milled to pass a 1-2 mm sieve to prepare DSP. Cookies were formulated by substituting WF with DSP at concentrations of 0 (T1), 20 (T2), 30 (T3), and 50% (T4), while maintaining constant levels of all other ingredients. Following baking at 180°C for 15-20 minutes, the cookies underwent sensory evaluation by a 30-member semi-trained panel using a 5-point hedonic scale. Selected samples were subjected to color analysis, proximate composition, total phenolic content (TPC), antioxidant activity (DPPH), texture profile analysis, and a shelf-life study to evaluate product stability. The 30% DSP formula, T3 was selected via sensory evaluation, as it achieved the highest scores for appearance, aroma, texture, flavor, aftertaste, and overall acceptability. T3 exhibited significantly ($P<0.05$) higher crude fiber (15.44±0.40%), protein (10.48±0.42%), and ash (8.24±0.03%) contents compared to the control, while maintaining lower moisture, fat, and carbohydrate levels. These findings highlight the nutritional improvements achieved through DSP substitution. Furthermore, the TPC and DPPH radical scavenging activity were significantly ($P<0.05$) enhanced in T3, making it a potent functional food with improved antioxidant properties. Color analysis showed stable lightness (L^*), while redness (a^*) and yellowness (b^*) significantly ($P<0.05$) increased. The spread ratio decreased with higher DSP levels, indicating gluten dilution. Further, DSP significantly ($P<0.05$) increased hardness and fracturability, reflecting gluten dilution and higher fiber content in T3. Shelf-life studies confirmed that microbial counts remained within safety limits for one month. In conclusion, substituting 30% wheat flour with DSP produces a nutritionally enriched, sensorially acceptable, and microbiologically stable functional cookie, offering a sustainable application for date fruit by-products.

Keywords: Date seed powder; food waste valorization; functional bakery product; nutritional enhancement; sensory evaluation



Paper ID: NSALS '26-037 (Poster)

Optimization of Enzymatic Decortication of Black Pepper (*Piper nigrum* L.) for White Pepper Production

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Black pepper (*Piper nigrum* L.), known as the “King of Spices”, is one of the most important spice crops in Sri Lanka. White pepper is a form of value addition to black pepper, and it fetches a higher price compared to black pepper in the spice market. Conventionally, white pepper is produced by decortivating black pepper through water retting, which is a time-consuming process that can reduce profitability and compromise product quality. Therefore, this study aimed to optimize the black pepper decortication process using an enzyme through Response Surface Methodology (RSM) with a Face Centered Central Composite Design (FCCD). During the optimization process, three process variables were evaluated: enzyme concentration (0.25-0.5%), temperature (45-55°C), and time duration (24-72 hours). Decortication percentage was taken as the response variable of the experiment. Sixty experimental trials were conducted, and a quadratic model was developed using Minitab v.22 statistical software. Statistical analysis showed that temperature, retting duration, their interaction effect, and the quadratic term of the enzyme concentration significantly affected the decortication percentage ($P < 0.05$). The quadratic model showed an acceptable predictive power (R^2) of 0.656 despite a significant lack of fit due to outliers in the experiment. Temperature showed a significant negative effect (-3.824), which may be due to the enzyme denaturation at higher temperatures. While retting duration showed a strong positive (+5.668) significant effect, the interaction demonstrated a significant negative effect (-6.33), emphasizing the harmful impact of combining high temperatures and prolonged retting duration. Optimized process conditions yielded a maximum decortication percentage of 46.86% at 0.5% enzyme concentration, 45°C, and a 72-hour retting period, with a composite desirability value of 0.63. White pepper produced under the optimum conditions exhibited excellent key physicochemical properties, including moisture content (11.5±0.07%), bulk density (654±4 g/L), and piperine content (5.51±0.60%). All parameters met or exceeded the respective standard requirements ($\leq 12\%$ moisture, ≥ 600 g/L bulk density, and $\geq 5\%$ piperine).

Keywords: Black pepper; decortication percentage; enzyme; face centered central composite design; response surface methodology; retting duration; white pepper



Paper ID: NSALS '26-058 (Poster)

Development of Papad-like Snack Incorporating *Kappaphycus alvarezii* and *Vigna mungo* Flour

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The demand for seaweed-based functional food products is growing rapidly due to changes of lifestyles such as increased health awareness and interest on plant-based diets. Seaweed is rich in nutrients, minerals and bioactive compounds. This study aims to develop a popular ready-to-fry, pulse-based snack by incorporating seaweed (*Kappaphycus alvarezii*) and *Vigna mungo* flour (black gram flour) into papad to enhance its nutritional and functional quality. Initially, proximate composition of raw *K. alvarezii* was analyzed. The experiment consisted of four treatments, each with three replicates. Seaweed pulp incorporated papad was developed with addition of seaweed pulp (0, 15, 30, 45% w/w) with 95 (T0), 80 (T1), 65 (T2), and 50% (T3) of black gram flour, respectively. Total amount of salt, pepper powder, garlic powder, curry leave powder and ammonium bicarbonate was kept constant at 5%. Final product was dried at 60°C and stored for 14 days. Samples were evaluated for proximate, physiochemical (expansion percentage, thickness, pH, antioxidant activity, and texture), microbial, and sensory characters for a 14-day storage period. Data were analyzed using one-way ANOVA followed by Tukey's test at 0.05 significance level. Seaweed incorporation statistically increased fiber, ash, and moisture levels while reducing fat, protein, and energy level. No significant difference detected in carbohydrate content ($P>0.05$) indicating most of carbohydrate content came from black gram flour. Expansion percentage significantly decreased with increasing seaweed levels. Thickness of papad had no significance difference among treatments. pH slightly decreased over days of storage in all treatments, with low pH (6.67 ± 0.32) observed in T3. Antioxidant activity significantly ($P<0.05$) increased with higher seaweed levels; gradual decline was observed in all treatments during storage. A significant difference was observed in hardness among treatments ($P<0.05$) along with storage periods. Microbial counts remained within safe limits. Sensory evaluation identified T2 (30% seaweed and 65% black gram flour) as the most acceptable. This study demonstrates that *K. alvarezii* pulp can be incorporated up to 30% in black gram flour to develop a nutritious, acceptable, and functional snack, promoting the value addition of underutilized seaweed resources in Sri Lanka.

Keywords: Antioxidant activity; bioactive compounds; *Kappaphycus alvarezii*; papad; physiochemical; sensory evaluation



Paper ID: NSALS '26-061 (Poster)

Improvement of Cinnamon (*Cinnamomum zeylanicum* L.) Bark Oil Distillation Recovery Percentage

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Steam distillation is the most widely used method for extracting cinnamon bark oil; however, oil recovery is highly dependent on operating conditions. This study focused on optimizing steam distillation conditions to improve the oil recovery percentage from Ceylon cinnamon (*Cinnamomum zeylanicum* L.) bark using a two-factor factorial experimental design. The effects of steam flow rate (50, 60, and 70 kg/h) and pressure (0.4, 0.6, and 0.8 bar) on extraction efficiency and oil quality parameters were evaluated using 200 kg batch operations with a six-hour distillation duration. The highest oil recovery of 55.23±0.40% was achieved at a steam flow rate of 70 kg/h and a pressure of 0.8 bar, reflecting a 63.4% improvement compared to the current oil recovery of the company (33.81±1.64%) at 50 kg/h of steam flow and 0.4 bar pressure. Statistical analysis revealed that both steam flow rate and pressure had highly significant effects on extraction efficiency ($P<0.05$), with a significant interaction indicating a synergistic improvement when both parameters were optimized together. The oil obtained under optimized conditions met international quality standards, with refractive index (1.5057-1.5228), specific gravity (0.9123-0.9376), density (0.9107-0.9360 g/cm³), and optical rotation (1.75-2.06°) all falling within acceptable ranges. GC-MS analysis identified 16 volatile compounds, with trans-cinnamaldehyde showing the highest concentration (11.19-24.85% peak area) under the tested extraction conditions, while the absence of coumarin confirmed the authenticity of Ceylon cinnamon, demonstrating that optimized steam distillation offers a sustainable and efficient approach for medium and large-scale cinnamon bark oil production.

Keywords: Cinnamon bark oil; factorial design; physicochemical properties; process optimization; steam distillation



Paper ID: NSALS '26-068 (Poster)

Influence of Fractionated Cocoa Butter on the Heat Stability of Dark Chocolates Formulated with Trinitario and Forastero (*Theobroma cacao* L.) Varieties

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The Heat Resistant Chocolate (HRC) concept arose from the underlying global need to maintain product quality, reducing supply chain costs caused by warm environmental conditions. Melting behavior of chocolate is primarily governed by the cocoa butter composition and polymorphic characteristics. Many approaches have been taken for HRC development, but little attention has been given to the incorporation of fractionated cocoa butter from specific varieties. This study aimed to evaluate how cocoa butter fractionation and cocoa variety influence the heat stability and melting behavior of dark chocolates. Ripen Forastero and Trinitario cocoa pods were processed and roasted (150°C) separately to extract cocoa butter, which was fractionated by centrifugation (16,200 RCF, 30 min, 45°C) into low-melting and high-melting fractions. The melting characteristics of produced 10 chocolate formulations (60% nibs, 30% sugar, 10% fractionated cocoa butter) were evaluated using two novel methods designed for this study: A quantitative penetrometer-based heat resistance test and a sensory-type snap test. Reductions in penetration resistance over time indicated softening. Snap characteristics assessed the structural sensitivity to temperature increase. Trinitario beans exhibited significantly higher total bean weight per pod (110.98±28.88 g) and bean count (39.50±6.78) compared to Forastero (95.19±29.94 g and 35.30±7.47, respectively; $P < 0.05$). Chocolates formulated with Trinitario cocoa butter showed superior or comparable heat resistance than Forastero counterparts. High-melting fractions significantly enhanced heat stability across all formulations ($P < 0.05$). Remarkably, the Trinitario chocolates produced from unfractionated butter displayed no significant difference with high-melting butter ($P > 0.05$), while Forastero unfractionated butter and low-melting butter having no significant difference ($P > 0.05$), suggesting similar fat profiles in compared samples. Snap tests further confirmed that the low-melting fractions of both varieties were most sensitive to temperature, resulting in a higher delta-snap index between 25-28°C. Overall, Trinitario cocoa butter exhibited inherent heat resistance making it more suitable for HRC development, while high-melting fractions of both varieties contributed for improved performance. These results highlight potential for optimizing chocolate formulations for warmer climates. Future work should examine Criollo butter due to its distinctive fat composition and potential contribution to heat resistance.

Keywords: Cocoa butter fractionation; delta-snap index; Forastero; heat resistant chocolate; *Theobroma cacao*; Trinitario



Paper ID: NSALS '26-075 (Poster)

Effect of Enzyme Pretreatment, Physical Form, and Distillation Time on Oil Yield of Black Pepper (*Piper Nigrum* L.), Extracted via Steam Distillation

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The essential oil (EO) yield from black pepper (*Piper nigrum* L.) via conventional steam distillation (SD) remains low and highly variable. This poor efficiency stems from the pepper's rigid cell wall structure and mass transfer limitations, coupled with the risk of thermal degradation during extended extraction cycles, which compromises final oil quality. This study used a single cultivar of *P. nigrum* from the same harvest batch and maturity level to control variability. A factorial experimental design was implemented, investigating three factors: Enzyme treatment [Multi-Blend (MB), pectinase (PEC), and control], physical form [whole, Coarse Cracked (CC), Medium Cracked (MC)], and distillation time (2 h and 4 h). The resulting data were analyzed using Factorial Analysis of Variance (ANOVA). Particle size distributions were standardized by sieve analysis, with MC samples passing through a US Standard Sieve No. 25 (0.7 mm) and CC samples through a US Standard Sieve No. 40 (0.4 mm). The highest oil yield (0.905 g/kg pepper) was obtained under the MC condition pretreated with the MB enzyme and subjected to 2 h of steam distillation. Notably, the shorter distillation time (2 h) produced a significantly higher yield than the 4 h treatment ($P < 0.05$), indicating advantages in both process efficiency and potential quality preservation. However, evaluating a wider range of distillation durations (1-6 h) would be beneficial for accurately identify the true optimum time. Further investigations using GC-MS analysis is recommended to characterize the volatile compound profile, along with polyphenolic analysis to confirm aroma quality and bioactive potential in relation to oil yield.

Keywords: Black pepper; enzyme-assisted extraction; essential oil; steam distillation; yield



Paper ID: NSALS '26-085 (Poster)

Development and Evaluation of Consumer Acceptability of Ready-to-Eat Breakfast Cookie from Finger Millet and Soy for Middle-aged Adults

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This study aimed to develop a ready-to-eat cookie using finger millet (*Eleusine coracana*) and soy flour (*Glycine max*) for middle-aged adults who often skip breakfast due to time constraints. Breakfast accounts for approximately 25% of total daily energy intake; its omission can significantly affect human health. Finger millet provides a high fiber content, which is important for digestibility, and soy flour enhances the protein content of the cookies. Three cookie formulations were prepared by varying the flour ratios: T1 (85% finger millet and 15% soy flour), T2 (75% finger millet and 25% soy flour), and T3 (60% finger millet and 40% soy flour). The remaining ingredients included fat, sugar, egg yolk, salt, and sodium bicarbonate. Sensory evaluation was done for 35 untrained panelists using a 7-point Hedonic scale presented distinctly higher values ($P < 0.05$) for color (5.67 ± 0.99), texture (5.36 ± 0.85), taste (5.43 ± 1.22), appearance (5.63 ± 0.89), aroma (5.06 ± 1.36), and overall acceptability (5.56 ± 0.81) of T2 when compared to the other two treatments. Proximate analysis by AOAC official methods indicated that selected T2 had a moisture content of $1.23 \pm 0.31\%$, protein $9.70 \pm 0.53\%$, fiber $4.60 \pm 0.20\%$, fat $12.43 \pm 0.25\%$, and ash $1.09 \pm 0.13\%$ (g/100 g). Physicochemical attributes, including total soluble solids (11.58 ± 0.38), pH (6.87 ± 0.09), weight (4.98 ± 0.18), diameter (41.79 ± 0.84), thickness (4.90 ± 0.20), and spread ratio (8.50 ± 0.26), were evaluated to assess the product quality. Furthermore, the antioxidant activity of the selected cookie formulation was determined using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical-scavenging assay ($28.13 \pm 0.12\%$) to evaluate cookie quality. Moisture content, pH, total plate count, and yeast and mold counts were examined over six weeks of storage to assess keeping quality. Statistical analysis revealed that the quality of the selected best treatment (T2) slightly changes during storage time. Overall, the 75% Finger millet and 25% soy flour cookie is a comfortable, nutritious, and sensorially acceptable breakfast that provides approximately 434 kcal/100 g of energy for middle-aged adults.

Keywords: Breakfast cookie; daily nutrition intake; finger millet; middle-aged adults; soy



Paper ID: NSALS '26-099 (Poster)

Potential of Antioxidant Enhancement in *Averrhoa carambola* through Probiotic Fermentation using *Streptococcus thermophilus* to Develop a Functional Beverage

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Averrhoa carambola (starfruit) is an abundant tropical fruit in southeast Asia including Sri Lanka, which is rich in numerous health promoting properties including antioxidant activity, hypoglycemic, antidiabetic, cardiovascular, and immune-boosting effects. However, starfruit is recognized as an underutilized fruit, due to limited new product development and its high levels of oxalic acid, and caramboxin. Fermentation is considered as a sustainable method of utilizing fruits while enhancing their nutritional value. This study aimed to evaluate the utilization of probiotic fermentation of starfruit juice with *Streptococcus thermophilus* (ST) as a viable method to enhance the antioxidant activity, total polyphenol content, and flavonoid content. Further, the study aimed to determine the optimal inoculation level of ST and time of fermentation to produce a functional beverage with optimum nutritional value. Defect-free, fully ripened fruits were peeled, diced, and blanched. The freshly extracted starfruit juice from the dices was pasteurized at 80°C for 5 minutes. The pasteurized juice was divided into four sections and was inoculated with activated ST starter culture (1.70×10^9 CFU/mL) at levels of 0, 1, 3, and 5% (v/v) and incubated at 42°C for various time intervals up to 72 h. During the fermentation, samples from each juice fermenter vessel were taken at 0, 24, 48, and 72 h intervals and were subjected to chemical analysis including, Radical-Scavenging Activity (RSA%), DPPH, total phenolic content (Folin–Ciocalteu), total flavonoid content (AlCl₃ Colorimetry), and oxalic acid content (UV-visible spectrophotometry). The microbial (ST) viability and pH were also analyzed during the above fermentation intervals. Based on the chemical analysis results, three best combinations with optimum nutritional value were selected to prepare three different beverages. The sensory evaluation was conducted (using 30 untrained panelists, 9-point hedonic). Results were analyzed using One-way ANOVA followed by Tukey HSD ($\alpha=0.05$) with triplicates. Results revealed a significant increase in RSA% as 86.79% (highest in 5% ST, 48 h), a slight increase in total phenolic content (10.19 ± 0.14 mg GAE/g), and total flavonoid content (4.63 ± 0.144 mg RE/g) (highest in 1% ST, 24 h and 72 h) with the fermentation. The pH was decreased with fermentation (lowest at 3% ST, 24 to 48 h). Probiotic fermentation improved sensory, nutritional, and functional qualities of starfruit juice, suggesting its potential as an antioxidant-rich fermented beverage for health-conscious consumers.

Keywords: Antioxidant activity; flavonoids; polyphenols; probiotic fermentation; starfruit; *Streptococcus thermophilus*



Paper ID: NSALS '26-108 (Poster)

Development and Optimization of Soy-based Yogurt with Enhanced Nutritional and Sensory Properties

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Yogurt has traditionally been identified as a fermented dairy food with nutritional values and sensory quality being its main advantages. The demand for nutritional aspects, as preferred by modern consumers, has recently seen the rise of soy yogurt, a product with high nutritional value and adequate amino acids, primarily because of high protein content. This study aimed to develop soy-based yogurt with reduced fat, enhanced protein content, and improved sensory quality. Conventional soy products often have a strong beany flavor and undesirable texture, limiting consumer acceptance. To overcome these issues, soy flour processed from soybean seeds was incorporated into pasteurized low-fat milk at varying concentrations [0, 1, 2, and 4% (w/w)], followed by homogenization, pasteurization, inoculation with a yogurt starter culture, and controlled fermentation until the desired acidity was achieved. The products were then cooled, packaged, and subjected to sensory, proximate, and shelf-life evaluations. The data were analyzed using One-way ANOVA and Friedman tests using Minitab v.17 software. Proximate analysis revealed that soy-based yogurts contained higher protein and lower fat levels than conventional dairy yogurt, with the 2% soy flour sample showing the most favorable results, including 81.89% moisture, 0.43% fat, 16.84% protein, 0.33% ash, 0.82% carbohydrates, and 74.54 kcal energy. Sensory evaluation identified this formulation (2%) as superior in texture, flavor, and overall acceptability. Shelf-life assessments over 1, 7 and 14 days confirmed product stability through consistent pH (4.69-4.54), acidity (0.69-0.80), water-holding capacity (14.95-41.45), and low syneresis (14.18-58.27). The findings demonstrate that the combination of soy flour and reduced-fat milk, along with optimized fermentation, can yield a nutritious, affordable, and consumer-acceptable yogurt alternative. This approach not only reduces undesirable fat content and enhances protein content but also contributes to the advancement of sustainable plant-based fermentation technologies, offering a functional food option that is vegetarian-friendly, health-conscious, and aligned with growing consumer demand for nutritious dairy alternatives.

Keywords: Fermentation; low-fat yogurt; nutritional composition; sensory evaluation; soy-based yogurt



Paper ID: NSALS '26-121 (Poster)

Optimize Extraction Process to Differentiate Natural and Artificial Sources of Methyl Salicylate in Black Tea

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Uva regional tea mainly contains natural methyl salicylate (MS), giving a minty taste and unique flavour. Hence, Uva tea has a high demand in the export markets and gains a acceptable price in the auction. However, this is a seasonal tea which can be available only from July to October each year. For these reasons, some tea producers in Sri Lanka adulterate MS with black tea to increase its minty taste. MS is a toxic compound, if used in excessive quantities and levels exceeding 150 mg/kg of body weight. Apart from health risks, this misleads consumers, violates food safety regulations, and affects the reputation of Sri Lankan tea in the global market. However, only limited analytical approaches are available which can distinguish between naturally derived and adulterated MS. Therefore, this study was designed to develop a method to differentiate the source of methyl salicylate in black tea samples. For this purpose, seasonal Uva tea was obtained from tea factories which contain a natural level of MS (control). Adulteration was performed by adding 10, 25 and 50 ppm levels of MS with tea leaves in (orthodox) rolling, after which the made tea samples were prepared. These samples were extracted using ethyl acetate at different combinations of temperatures [room temperature 25 (RT), 40 and 50°C] and extraction time intervals (45, 75, and 105 mins). A standard calibration curve was constructed and MS level in the extracts were quantified using gas chromatography-mass spectrometry. At room temperature, MS concentration increased with longer extraction times. Whereas at 40°C and 50°C, MS concentration decreased over the extraction time. Specifically, the control sample showed a considerably higher MS concentration than the adulterated samples at 105 minutes at room temperature. Nevertheless, no considerable differences were observed for any extraction time at 40°C. The control sample showed very high MS concentration at all extraction times at 50°C. This may be due to the levels of adulteration (10, 25, and 50 ppm) were lower than the natural level. These findings showed that 50°C is more suitable for differentiating natural and artificial sources of MS. Further studies are recommended to optimize the extraction temperature and time to enhance the differentiation between natural and artificial sources of methyl salicylate in tea.

Keywords: Extraction time; gas chromatography-mass spectrometry; methyl salicylate; minty taste; tea adulteration; temperature



Paper ID: NSALS '26-123 (Poster)

Optimization of Steam Sterilization Conditions for Curry Leaves (*Murraya koenigii*) to Preserve Quality Attributes

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Curry leaves (*Murraya koenigii*) are a miracle spice herb in south Asian cuisine and traditional medicine, known for aromatic, nutritional, and therapeutic qualities. However, thermal processing like steam sterilization, required for microbial safety and shelf life, has an adverse effect on color, bioactive compounds, and sensory quality. Steam sterilization temperature and duration for curry leaves were optimized to ensure effective microbial reduction while minimizing quality degradation. Using a face-centered central composite design in Response Surface Methodology (RSM), experiments were conducted with temperature (70-80°C) and time (2-4 min) as factors. The evaluated responses included microbial log reductions (coliform, total plate count, yeast and mold, *Escherichia coli*), ΔE (color change), moisture content, antioxidant activity, and chlorophyll content. General linear models and ANOVA confirmed significant effects and interactions ($P < 0.001$), with Tukey comparisons identifying optimal groupings. RSM optimization yielded the best conditions at approximately 70.8°C for 4 minutes, with a desirability of 0.599, delivering log reductions of 4.25 (coliform), 3.49 (total plate count), 2.38 (yeast and mold count), and *E. coli* was not detectable, alongside minimal ΔE (2.09), preserved moisture (11.00%), antioxidant activity expressed as inhibition percentage (71.55%), and chlorophyll (1.46 mg/g). Sensory attributes, assessed via hedonic scales for brittleness, aroma, mouthfeel, and overall acceptability, aligned with these physicochemical improvements. This protocol effectively ensured microbial safety while preserving color, moisture, antioxidant activity, chlorophyll content, and sensory quality, demonstrating a balanced and industry-applicable processing conditions to providing industrial guidelines for exporters to comply with standards, minimize quality failures, and enhance economic viability. Future research could validate scaling and additional bioactive compounds.

Keywords: Antioxidant activity; color degradation; microbial log reduction; *Murraya koenigii*; response surface methodology; steam sterilization



Paper ID: NSALS '26-131 (Poster)

Assessment of Bee Honey Quality and Associated Floral Diversity: A Case Study in Badulla District, Sri Lanka

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Bee honey composition varies depending on floral origin, geographical location, and environmental conditions. However, the relationship between floral diversity, physicochemical properties, and consumer perception of honey quality has received limited investigation in Badulla district of Sri Lanka. This study aimed to evaluate the quality of bee honey by establishing correlations among floral diversity, physicochemical characteristics, and consumer preferences. A total of 98 honey samples were collected using snowball sampling method from major Divisional Secretariats and Agrarian divisions of Badulla District, including Badulla, Bandarawela, and Welimada, together with information on associated floral resources. Sensory evaluation was conducted using 30 untrained panelists based on a 9-point hedonic scale, while physicochemical parameters including moisture content, pH, free acidity, Total Soluble Solids (TSS), Total Phenolic Content (TPC), Total Antioxidant Activity (TAA), and water activity were analyzed following standard AOAC methods. The results revealed a significant variation ($P < 0.05$) in both physicochemical and sensory characteristics among the honey samples. Among the sample, Sample No.18 recorded the highest overall consumer preference, while five additional samples also demonstrated notable consumer acceptability based on mean hedonic scores. Moisture content showed a strong positive correlation with water activity ($r = 0.91$, $P < 0.01$), and TPC was strongly correlated with TAA ($r = 0.87$, $P < 0.01$) Furthermore, higher phenolic content and antioxidant capacity were associated with dominant floral sources, particularly contributions from mango (*Mangifera indica*), tea (*Camellia sinensis*), banana (*Musa* spp), tuna cactus (*Opuntia* spp) and red gum (*Eucalyptus camaldulensis*). The findings confirm that honey quality in Badulla is influenced by both intrinsic physicochemical properties and extrinsic floral diversity, which together affect consumer preferences. These results enhance understanding of honey authenticity, support marketability, provide scientific baseline data for Sri Lankan honey quality, and promote agriculture-based sustainable livelihood opportunities.

Keywords: Antioxidant activity; consumer preferences; floral diversity; physicochemical properties; Sri Lankan honey



Paper ID: NSALS '26-139 (Poster)

Comparative Evaluation of Antioxidant Activities in Raw Coconut (*Cocos nucifera* L.) Protein Isolates

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Coconut is a promising source of food-grade protein, offering both nutritional and functional benefits. Proteins are essential for human growth and development, and bioactive peptides, produced through enzymatic hydrolysis have gained recognition for their health promoting properties, including antioxidant, antihypertensive, and antitumor activities. The antioxidant functionality of coconut crude protein hydrolysates has not been extensively investigated. As industries increasingly seek natural alternatives to synthetic antioxidants for health and sustainability, evaluating the antioxidant properties of coconut protein becomes essential. This study assessed the antioxidant capacity of coconut crude protein hydrolysates using three assays: 2,2-diphenyl-1-picrylhydrazyl (DPPH), Ferric Reducing Antioxidant Power (FRAP), and Thiobarbituric Acid Reactive Substances (TBARS). Proteins were extracted under optimized alkaline conditions (NaOH, pH 10.5, 60°C, 90 min), yielding 6.564 mg/mL (wet weight basis) which is a moderate yield compared to other plant sources, and hydrolyzed using pepsin, trypsin, and the INFOGEST protocol, which mimics human gastrointestinal digestion to provide physiologically relevant insights. All assays included untreated coconut protein isolates as controls. The degree of hydrolysis was quantified using the o-phthalaldehyde assay. Pepsin hydrolysates showed the highest radical scavenging activity (84%) in the DPPH assay, suggesting that coconut-derived peptides may offer health benefits by reducing oxidative stress. However, pepsin-treated samples exhibited lower ferric-reducing power (0.135 mM), likely due to reduced electron-donating capacity following enzymatic cleavage. TBARS analysis revealed reduced malondialdehyde levels in INFOGEST-treated samples, indicating lower lipid peroxidation (0.245 nmol) and enhanced oxidative protection. These findings suggest that enzymatic hydrolysis enhances the antioxidant potential of coconut proteins, supporting their application in functional foods, cosmetics, and anti-inflammatory products. Future peptide sequencing will clarify the molecular basis of the antioxidant effects.

Keywords: Coconut protein; DPPH assay; enzymatic hydrolysis; FRAP assay; TBARS assay



Paper ID: NSALS '26-168 (Poster)

Development of a Probiotic Ice Cream using Beetroot (*Beta vulgaris* L.) Extract as a Natural Colorant and *Saccharomyces boulardii* as a Functional Probiotic

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The growing demand for functional foods has driven research into novel probiotic carriers, with consumers increasingly seeking health-promoting, natural, and clean-label products. This study developed and evaluated a beetroot-enriched probiotic ice cream incorporating *Saccharomyces boulardii*, a resilient probiotic yeast with gut health benefits. A pre-culture of *S. boulardii* was prepared by heat-treating milk at 72°C for 15 minutes, cooling to 37°C, inoculating the yeast, and fermenting under anaerobic conditions until pH 5.8 before ice cream production. Ice cream formulations included a control without beetroot extract or probiotic, a formulation containing 5% beetroot extract without probiotic, and formulations containing 5% beetroot extract supplemented with 0.5, 1, and 2% *S. boulardii*, which were stored at -18°C for 21 days. Antioxidant activity was assessed via DPPH scavenging, alongside physicochemical properties (pH, Brix, titratable acidity, total phenolic and flavonoid content), physical characteristics (overrun, melting rate), probiotic viability, and sensory attributes. After 21 days, the control showed the lowest DPPH activity, while beetroot-containing ice creams had significantly higher antioxidant capacity ($P < 0.05$). The 5% beetroot formulation without probiotic reached $36.74 \pm 0.16\%$, whereas the 5% beetroot with 1% *S. boulardii* achieved the highest activity at $67.31 \pm 1.98\%$ ($P < 0.05$). Formulations with 0.5 and 2% *S. boulardii* also exhibited higher antioxidant activity than the beetroot-only ice cream, indicating a synergistic effect between beetroot bioactive and probiotic yeast. Probiotic viability remained above the recommended therapeutic level ($> 10^6$ CFU/g) throughout storage. Sensory evaluation showed no significant differences in appearance, color, or texture ($P > 0.05$), while taste, mouthfeel, and overall acceptability varied significantly ($P < 0.05$), with the 5% beetroot and 1% *S. boulardii* formulation receiving the highest overall acceptability. Beetroot addition enhanced the antioxidant capacity as well as providing a stable red-violet color to the ice-cream. These results demonstrate the feasibility of producing naturally colored probiotic ice cream with enhanced antioxidant activity, stable probiotic viability, and high consumer acceptance.

Keywords: Antioxidant stability; beetroot extract; DPPH scavenging activity; probiotic ice cream; *Saccharomyces boulardii*; sensory evaluation



Paper ID: NSALS '26-173 (Poster)

Development and Nutritional Evaluation of Shrimp Shell Powder Enriched Pasta

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Shrimp shells are a rich source of bioactive compounds, including chitin, protein, lipids, essential minerals, and astaxanthin, a powerful natural antioxidant. Incorporating shrimp shell powder (SSP) into commonly consumed food products can enhance their nutritional and functional properties while promoting environmental sustainability by utilizing seafood processing by-products. This study aimed to develop and evaluate SSP incorporated pasta for its nutritional, physicochemical, and sensory properties. Shrimp shell waste was collected hygienically soon after deshelling at a seafood processing plant. Shells were cleaned, blanched, and dehydrated at 45°C, for 24 h using a hot air oven. The dried shells were powdered into a fine particle size, analyzed for chemical composition, and used for pasta formulations at 0, 10, 15 and 20% concentrations with 100, 90, 85, and 80% levels of wheat flour respectively, and other ingredients (eggs and salt). Pasta samples with different SSP levels were evaluated for their nutritional composition, physicochemical properties, antioxidant activity, and sensory attributes. Texture profile analysis was conducted for fresh pasta samples and adhesiveness, springiness, cohesiveness, gumminess, and chewiness were measured using a texture analyzer and light knife blade. Proximate analysis of the SSP showed 8% moisture, 11.43% protein, 22.86% ash, and 7.32% lipid content. It also contained 6.098 µg/g of astaxanthin, and 28.45% chitin. SSP enriched pasta samples demonstrated higher protein and lipid content than the control. The DPPH radical scavenging activity increased progressively with SSP incorporation, recorded as 10.92, 18.21, 22.61, and 25.71% for 0, 10, 15, and 20% SSP levels, respectively. Among the different formulations, the pasta with 20% SSP inclusion was preferred during sensory evaluation, receiving the highest scores for appearance, taste, aroma, color, texture, and overall acceptability. The study demonstrated that incorporating shrimp shell powder successfully enhanced the nutritional profile of pasta, resulting in a value-added product rich in astaxanthin, chitin, protein, and radical scavenging activity, with promising potential as a functional food.

Keywords: Astaxanthin; functional food; industrial by-product; pasta; shrimp shell powder



Paper ID: NSALS '26-179 (Poster)

Development of a Refreshing Beverage: Coconut Water Lemonade Incorporated with Black Pepper (*Piper nigrum* L.)

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Coconut water, a byproduct of Sri Lanka's coconut industry, is often underutilized. This underutilization leads to nutritional waste and economic losses. This study aimed to develop and optimize a functional beverage by blending coconut water with lemon flavor and black pepper powder, and to evaluate its physicochemical, nutritional, and microbial stability. Mature coconut water was collected, filtered, and blended with other ingredients. Different beverage formulations (n=4) were developed by varying black pepper concentration, with sugar (6%) and lemon flavor (0.10%) held constant. The formulation containing 0.04% black pepper showed the highest acceptability, with an overall score of 6.5. The formulation was optimized through sensory evaluation using a 7-point hedonic scale with 30 untrained panelists, which may reflect consumer preferences rather than trained sensory assessors. The beverage was pasteurized (80°C for 15 s) and stored at 4°C. Proximate analysis revealed moisture (89.27±0.44%), protein (0.55±0.13%), fat (1.03±0.07%), fiber (0.03±0.003%), ash (0.92±0.042%), and total solids (10.73±0.44%). Physicochemical assessments showed an initial pH of 4.40±0.0, total soluble solids of 13.5±0.0 °Brix, titratable acidity of 0.25±0.01 g/L, and ascorbic acid content of 18.47±0.45 mg/100 mL. Total phenolic content was 89.33±4.16 mg GAE/100 mL, and antioxidant activity (DPPH assay) was 94.84±0.54%. During 4-week storage at 4°C, slight decreases in pH, ascorbic acid, antioxidant activity, and total phenolics were observed, while titratable acidity and turbidity increased slightly ($P<0.05$). Microbiological analysis indicated the absence of coliforms, with yeast and mold counts remaining negligible; however total plate counts increased to 6.96±0.03 log CFU/mL, which remains within acceptable limits for non-fermented beverages. This beverage transforms coconut byproducts into a stable, antioxidant-rich beverage, thereby, contributing to the sustainable utilization of Sri Lanka's coconut industry.

Keywords: Black pepper (*Piper nigrum* L.); coconut water; functional beverage; proximate composition; sensory evaluation



Paper ID: NSALS '26-194 (Poster)

Nutritional Profiling and Development of a Dairy Dessert Incorporating *Nymphaea nouchali* Flower Extracts

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Growing consumer interest in health-promoting foods has intensified the search for natural ingredients rich in bioactive compounds. The incorporation of edible flowers into food products has emerged as a promising trend in the modern food industry. *Nymphaea nouchali*, a medicinal flower used in Ayurveda and Siddha medicine, contains flavonoids, gallic acid, astragaloside, quercetin, and kaempferol, like bioactive compounds that confer numerous medicinal properties. This study aimed to develop a dairy dessert fortified with water lily flower and evaluate its nutritional profile. Water lily flowers were dehydrated at 48°C for 24 h using a drying oven. Water lily Flower Extract (WFE) was obtained by infusing dried flowers with water (1:20 ratio) at 60°C for 15 minutes. Formulations were prepared using concentrations of 90, 85, 80, 75, and 70% fresh milk, combined with constant amounts of sugar, gelatin, and vanilla flavor. The mixture was pasteurized at 90°C for 5 minutes, cooled, and supplemented with varying percentages of WFE (0, 5, 10, 15, and 20%). Samples were stored at 4°C. Radical scavenging activity, total phenolic content, and total flavonoid content were assessed using DPPH, Folin-Ciocalteu, and aluminum chloride methods, respectively. The pH and texture profile measurements of the dairy desserts were conducted on 1, 7, and 14 days of storage at refrigerated storage. Elemental composition of dehydrated WF powder was determined via inductively coupled plasma optical emission spectrometry. Shelf life was assessed using the total plate count method, and sensory evaluation was conducted using a 9-point hedonic scale with 30 untrained panelists. Desserts with 5% WFE showed the highest antioxidant activity (85.2%), while 20% WFE exhibited significantly higher phenolic content (43 mg GAE/g). The highest flavonoid content (0.99 mg/mL) occurred in the 15% WFE formulation. Hardness was significantly greater in 20% WFE desserts on day 1 (36.67±7.51; $P<0.05$), whereas gumminess, cohesiveness, and chewiness were unaffected by WFE level during storage. Sensory evaluation identified 15% WFE as the most preferred formulation ($P<0.05$). Although pH decreased during storage (5.79-7.45), microbial counts remained within acceptable limits. This study validates water lily flower as a nutritious and sensory-acceptable ingredient, valorizing an underutilized natural resource.

Keywords: Antioxidant activity; functional dairy dessert; *Nymphaea nouchali*; sensory evaluation; texture profile analysis



Paper ID: NSALS '26-217 (Poster)

Natural Tenderization of Spent Broiler Breeder Hen Meat with Ginger and Tamarind: Implications for Value-added Meat Product Development

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This study investigated the use of natural tenderizing agents-ginger extract and tamarind pulp paste to enhance the physicochemical and sensory characteristics of spent broiler breeder hen (SBBH) meatballs. Fresh deboned SBBH thigh meat and fat were obtained from a commercial processing facility. Four formulations were developed to evaluate the tenderizing potential of these ingredients in meatballs prepared following standard commercial guidelines: a control (no tenderizer), a 3% ginger extract treatment, a 1.5% tamarind pulp paste treatment, and a combined treatment incorporating 1.5% ginger extract with 0.75% tamarind pulp paste. These formulations were selected based on preliminary optimization experiments that identified effective tenderizer concentrations for texture and sensory improvement. The tenderization effectiveness was evaluated through shear force, texture profile analysis, and myofibrillar fragmentation index (MFI). Proximate composition and physicochemical parameters such as pH, cooking loss, water-holding capacity, color, texture, and lipid oxidation (TBARS assay) were determined over 28 days of frozen storage (-18°C). All experiments were conducted in triplicates. Sensory evaluation was conducted using 30 untrained panelists, who rated appearance, color, aroma, taste, texture, tenderness, juiciness, mouthfeel, and overall acceptability on a 9-point hedonic scale. Data were analyzed using One-way ANOVA and Friedman tests to determine significant differences ($P < 0.05$). The combination treatment of 1.5% ginger extract and 0.75% tamarind pulp paste significantly reduced the shear force value from 32.5 ± 1.8 N in the control to 22.6 ± 1.2 N ($P < 0.05$), while MFI increased from 71.2 ± 3.4 to 98.7 ± 4.1 . The same treatment showed the lowest TBARS value (0.45 ± 0.02 mg MDA/kg) compared with the control (0.78 ± 0.03 mg MDA/kg), indicating improved lipid stability during frozen storage. Sensory evaluation revealed significantly higher scores for texture, juiciness, mouthfeel, and overall acceptability in the combination treatment compared to the control ($P < 0.05$). No significant differences were observed in color or appearance among treatments. These findings demonstrate that ginger extract and tamarind pulp paste can effectively improve tenderness, lipid stability, and sensory quality of SBBH meatballs. Their use offers a sustainable means of upgrading underutilized poultry resources into high-quality, value-added products suitable for both industrial and household-level applications.

Keywords: Ginger extract; myofibrillar fragmentation index; natural tenderizer; shear force; tamarind pulp paste

Underlined is the presenting author.



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Evaluation of Different Thawing Methods on the Physicochemical and Sensory Properties of Chicken Sausages

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Freezing is an essential preservation method for meat products, but improper thawing can lead to undesirable changes in texture, moisture retention, and sensory quality. This study evaluated the effects of four thawing methods like Room Temperature Thawing (RTT), Room Temperature Water Thawing (RTWT), Cold Water Thawing (CWT), and Microwave Thawing (MT) on the physicochemical and sensory characteristics of two types of chicken sausages: normal (diameter-16 mm, length-90 mm) and jumbo (diameter-26 mm, length-160 mm). Frozen, commercially prepared chicken sausages were thawed under each condition following commonly used household handling practices. Physicochemical parameters such as texture profile (hardness, adhesiveness, cohesiveness, springiness, and gumminess), shear force, moisture content, and Water Holding Capacity (WHC) were determined using standard analytical methods. Sensory evaluation was conducted by a 30-member untrained panel using a seven-point hedonic scale for appearance, color, aroma, flavor, hardness, juiciness, and overall acceptability. Results indicated that no significant differences ($P>0.05$) were observed among thawing treatments for either sausage type. For normal sausages, hardness ranged from 4.77 ± 0.03 (RTT) to 5.45 ± 0.02 (RTWT), while for jumbo sausages, it ranged from 4.45 ± 0.06 (RTWT) to 6.58 ± 0.01 (RTT). Shear force values showed similar non-significant variation between 10.35 ± 2.45 N (CWT) and 13.07 ± 1.70 N (RTWT) in normal sausages, and between 23.45 ± 1.45 N (CWT) and 31.50 ± 2.32 N (MT) in jumbo sausages. Moisture content varied between 61.9 and 62.5% in normal sausages and between 68.5 and 81.7% in jumbo type, while WHC ranged from 45.5 to 58.4% in normal sausages and from 68.1 to 83.5% in jumbo type. In sensory analysis, overall acceptability scores were consistent across treatments, averaging 5.5-5.7 for both sausage types ($P>0.05$). Minor numerical differences were observed, with CWT yielding slightly higher aroma and juiciness scores ($\approx 5.8\pm 0.2$), suggesting marginal sensory preference. The findings confirm that all four thawing methods maintained comparable physicochemical and sensory qualities in chicken sausages. Although no quality superiority was observed of treatments, microwave thawing was identified as the most efficient and time-saving method, supporting its potential use in both industrial and household meat processing operations.

Keywords: Chicken sausages; sensory evaluation; shear force; texture profile; thawing methods; water holding capacity



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Chemical Characterization of Tea Fluff: A By-product of Secondary Tea Processing

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Tea fluff is a fine powdery by-product generated during secondary black tea processing and is produced in substantial quantities annually. However, its chemical composition remains poorly characterized, limiting its potential commercial utilization. The objective of this study was to evaluate the chemical characteristics of tea fluff by analyzing its total polyphenol content, caffeine content, and antioxidant activity, and to compare these parameters with a standard commercial black tea grade (off grades). Tea fluff samples were collected from ten tea factories, while off-grade tea was used as the control sample. Total polyphenol content was determined using the Folin-Ciocalteu assay and expressed as mg gallic acid equivalents per gram (mg GAE/g). Caffeine content was determined spectrophotometrically by partitioning caffeine from the methanolic tea extract into chloroform and measuring the absorbance of the chloroform extract at 276 nm. Antioxidant activity was evaluated using the 2,2-diphenyl-1-picrylhydrazyl radical scavenging assay and expressed as mg ascorbic acid equivalents per gram (mg AAE/g). Statistical analysis was performed using One-way ANOVA. The total polyphenol content of tea fluff samples was 87.07 ± 10.54 mg GAE/g, with values ranging from 68.14-98.04 mg GAE/g. The caffeine content of tea fluff samples ranged from 3.88-4.06%. The antioxidant activity of tea fluff samples was 18.82 ± 0.74 mg AAE/g. No significant differences were observed between tea fluff and the control for total polyphenol content, caffeine content, or antioxidant activity ($P > 0.05$). However, certain tea fluff samples exhibited slightly higher antioxidant activity, indicating natural variability among factories. The results confirm that tea fluff contains substantial bioactive compounds with antioxidant potential comparable to commercial black tea. Therefore, tea fluff has strong potential for value-added applications in functional foods, nutraceuticals, and cosmetic products. Utilization of tea fluff can reduce industrial waste and support sustainable practices within the tea industry.

Keywords: Antioxidant activity; caffeine content; chemical characterization; DPPH Assay; Folin-Ciocalteu assay; tea fluff



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Preparation and Quality Evaluation of Spicy Jam Made from Unripe Mango (*Mangifera indica*)

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Mango post-harvest loss remains a major challenge in the fruit processing industry, particularly when producing value-added products like jams. However, scientific studies on spicy jams formulated using unripe mangoes are scarce, creating an opportunity to utilize excess green fruit and introduce new product variations. This study aimed to create and characterize a new spicy jam made of unripe mango (*Mangifera indica* var. Karutha Kolomban) and Scotch bonnet (*Capsicum frutescens*). Three initial formulations were prepared, and sensory evaluation (flavor, sweetness, mouthfeel, color, aroma, spiciness, overall acceptance) was conducted with 30 untrained panelists using a 9-point hedonic scale. The Total Soluble Solids (TSS), pH, proximate, and total plate count test and yeast and mold testing were done for the selected formulation from the sensory analysis. The optimal formulation, selected by sensory evaluation, contained 47.6% mango pulp, 47.6% sugar, 0.8% salt, 0.7% scotch bonnet (*Capsicum frutescens*), and 0.2% pectin. Sensory analysis indicated high consumer acceptance, particularly for taste and overall liking, reflecting the appeal of the sweet-spicy flavor profile. The jam exhibited 22.1% moisture, 1.2% ash, 0.4% protein, 1.2% crude fiber and trace fat, with physicochemical parameters within acceptable ranges (pH 2.96±0.14, 71% TSS, and 1.52±0.06% titratable acidity). Microbiological analysis demonstrated product safety, with total plate counts below 10 CFU/g, which is significantly lower than the maximum permissible limits defined by Sri Lanka Standards, and absence of yeast and mold throughout the evaluation period (30 days at ambient storage). The conclusion of the study is that spicy mango jam made from unripe mangoes is a safe, shelf-stable, and acceptable product by the consumer with a prospective of being commercialized as a value-added fruit product. Future research should be done on the long-term shelf life, fortification approaches, and scaling-up of production.

Keywords: Mango; quality evaluation; scotch bonnet ; spicy jam



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