2nd

ICAPS SUSL

INTERNATIONAL CONFERENCE ON

APPLIED SCIENCES

"Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future"

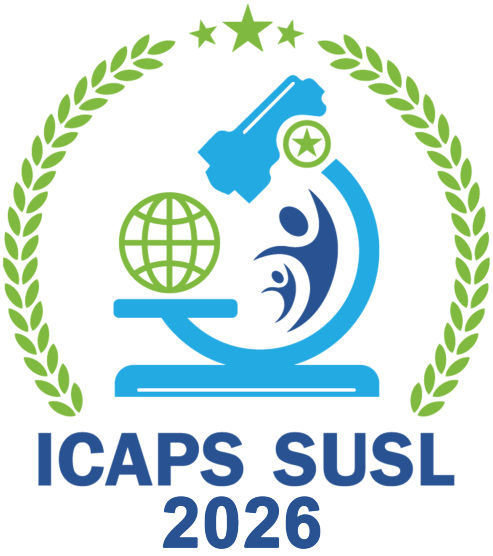
19th August 2026

Faculty of Applied Sciences
Sabaragamuwa University
of Sri Lanka

ABSTRACTS

ICAPS 2026

2nd International Conference on Applied Sciences



19th August 2026
Sabaragamuwa University of Sri Lanka
Belihuloya, Sri Lanka

ICAPS 2026

2nd International Conference on Applied Sciences

Sabaragamuwa University of Sri Lanka

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Organized by the **Faculty of Applied Sciences**
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About ICAPS 2026

ICAPS 2026 provides a platform for researchers, academics, professionals, and students to share the findings of their research with an extensive research and scholarly community, thereby exposing them to broad academic and industrial opportunities and research collaborations with leading industries.

It encourages participants to examine local and global trends in their fields of research and to share developments in applied sciences, technology, innovation, skills, knowledge, and investment.

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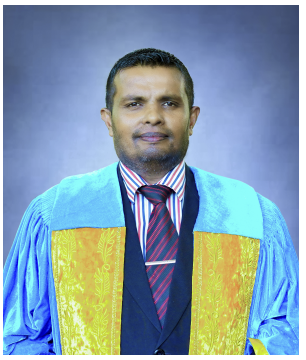
Message from the Actg. Vice Chancellor, Sabaragamuwa University of Sri Lanka

It is with great pleasure and pride that I extend my warmest greetings on the publication of the Abstract Book of the 2nd International Conference on Applied Sciences (ICAPS SUSL 2026), organized by the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. Held under the theme "Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future," ICAPS SUSL 2026 reflects our University's commitment to advancing knowledge, promoting innovation, and contributing meaningfully to the challenges confronting our society and the wider world. In an increasingly complex and interconnected world, addressing these challenges requires collaboration across disciplines, institutions, and national boundaries. As Louis Pasteur aptly observed, "Science knows no country, because knowledge belongs to humanity." This spirit of openness and collaboration is at the heart of an international conference such as ICAPS SUSL 2026. By bringing together academics, researchers, industry professionals, policymakers, and students, the conference provides an important platform for exchanging knowledge, sharing ideas, developing partnerships, and exploring innovative responses to global challenges. The diverse thematic areas - Computer Science and Information Technology, Food Science, Earth and Environmental Sciences, Chemistry, and Physics - demonstrate the breadth of scientific inquiry within the Faculty of Applied Sciences and provide opportunities for meaningful interdisciplinary engagement. Through keynote and plenary lectures, oral and poster presentations, workshops, and panel discussions, the conference seeks not only to disseminate research but also to strengthen collaboration among universities, research institutions, industry, and other stakeholders. I am particularly pleased that the conference places strong emphasis on connecting research with practical application. The ultimate value of scientific knowledge lies not only in its generation but also in its capacity to contribute to innovation, sustainable development, environmental resilience, and societal well-being. I also wish to acknowledge the importance of maintaining rigorous academic standards. My sincere appreciation goes to Microsoft for generously providing the Microsoft CMT service free of charge, including support for Azure cloud services, software development, and technical assistance, thereby facilitating an efficient and systematic peer-review process. I extend my deepest appreciation to the Faculty of Applied Sciences, the Organizing Committee, reviewers, session chairs, academic and administrative staff, and all others whose dedication has contributed to the organization of ICAPS SUSL 2026. To all participants, I encourage you to make full use of this opportunity to exchange ideas, challenge existing thinking, establish new collaborations, and inspire further research and innovation. May the knowledge shared and partnerships established through this conference extend well beyond the conference itself and contribute to a more sustainable, resilient, and prosperous future. I wish ICAPS SUSL 2026 every success and all participants a stimulating, productive, and memorable conference.

Professor S. A. Ariadurai
Actg. Vice Chancellor
Sabaragamuwa University of Sri Lanka

Message from the Dean, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka



On behalf of the Faculty of Applied Sciences at Sabaragamuwa University of Sri Lanka, it is my great pleasure to warmly welcome you to the 2nd International Conference on Applied Sciences (ICAPS SUSL 2026), held under the theme "Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future". Building on the success of our inaugural conference, ICAPS SUSL 2026 continues to provide a distinguished international platform for promoting multidisciplinary research, fostering innovation, and strengthening collaboration among academics, researchers, industry professionals, policymakers, and practitioners from around the world. I am confident that this conference will further enhance scientific knowledge exchange, inspire innovative research, and contribute to addressing global challenges through interdisciplinary collaboration.

The primary objective of the conference is to provide an international platform for academic and industrial research and to enable researchers and scholars to disseminate their latest findings to a broader scientific community. ICAPS SUSL 2026 also offers valuable opportunities for participants to establish collaborations, exchange knowledge, and engage with academics, researchers, and industry experts from diverse disciplines and countries. Through keynote addresses, technical sessions, and scholarly discussions, the conference encourages the sharing of innovative ideas, emerging technologies, and recent scientific advancements. Such interactions foster interdisciplinary collaboration, broaden research perspectives, strengthen professional networks, and inspire future research initiatives, thereby contributing to the advancement of applied sciences and sustainable development. The research presented at ICAPS SUSL 2026 has the potential to generate innovative solutions, advance scientific knowledge, support technological development, and contribute to the creation of new products, industries, and employment opportunities. By promoting evidence-based research and interdisciplinary collaboration, the outcomes of this conference are expected to make meaningful contributions to sustainable development, economic growth, and the overall well-being of society. I would like to express my sincere gratitude to the Honorable Vice Chancellor, distinguished keynote and invited speakers, reviewers, sponsors, authors, and participants for their invaluable contributions to the success of ICAPS SUSL 2026. I also extend my heartfelt appreciation to the Organizing Committee and the academic and non-academic staff of the Faculty of Applied Sciences for their dedication, commitment, and outstanding efforts in organizing this conference. Their unwavering support and teamwork have been instrumental in making this event a success. Finally, I convey my warmest best wishes to all presenters and participants, and I hope that ICAPS SUSL 2026 will provide a rewarding and inspiring experience for everyone involved.

Professor R. M. Kapila Tharanga Rathnayaka
Dean, Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

Message from the Chair, 2nd International Conference on Applied Sciences, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka.

It is with great pride and honour that I warmly welcome you to the 2nd International Conference on Applied Sciences, Sabaragamuwa University of Sri Lanka (ICAPS 2026), held on 19th August 2026 at the University premises in the beautiful setting of Belihuloya, under the theme "Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future." ICAPS 2026 provides a vibrant platform for leading scientists, academics, industry professionals, researchers, and research scholars to share knowledge, exchange ideas, and foster meaningful collaborations to address the scientific and technological challenges of our time. This year's conference brings together research and innovation across five broad and interconnected tracks: Digital Innovation and Intelligent Technologies for Sustainable Societies: Computer Science & IT, Food Innovation, Safety and Security for Sustainable Nutrition: Food Science, Earth System Science and Environmental Resilience : Environmental Science, Chemical Sciences for Green Innovation and Sustainable Development : Chemistry and Advances in Physical Sciences and Technologies for Future Sustainability – Physics We are honoured and delighted to welcome Prof. (Dr.) Albert Schulte and Prof. (Dr.) Wipa Suginta from the Vidyasirimedhi Institute of Science and Technology (VISTEC), Thailand, as the Keynote Speakers of ICAPS 2026. Prof. Schulte is an eminent scientist whose contributions to biosensing and related interdisciplinary research have made a significant impact, while Prof. Suginta is a distinguished expert in enzyme biochemistry and related areas of molecular science. We greatly value their participation and look forward to the insights, expertise, and inspiration they will share with our conference community. This year, we received nearly 100 abstracts, reflecting the growing interest and enthusiasm for applied scientific research and innovation. Following a comprehensive peer-review process, 65 abstracts have been selected for presentation across the five conference tracks. Each contribution represents the dedication, creativity, and commitment of researchers working to advance knowledge and develop innovative solutions for a sustainable future. As the Organising Committee, it is our great pleasure and privilege to host ICAPS 2026 and to bring together such a diverse and vibrant community of researchers. We sincerely appreciate the contributions of all authors, reviewers, keynote speakers, plenary speakers, session chairs, organising committee members, technical staff, and everyone who has worked tirelessly to make this conference possible. Finally, I extend my heartfelt gratitude to all participants for joining us at Sabaragamuwa University of Sri Lanka. ICAPS 2026 will provide not only an enriching academic experience but also opportunities to establish lasting collaborations, exchange innovative ideas, and create new pathways towards a sustainable and resilient future. I wish you all a productive, inspiring, and memorable conference.

Dr. H. Sasimali M. Soysa
Chair, 2nd International Conference on Applied Sciences – ICAPS 2026
Sabaragamuwa University of Sri Lanka

Keynote Address by Professor (Dr) Albert Schulte/Professor (Dr) Wipa Suginta

Streamlining Electrochemical Enzyme Biosensors: Toward Practical, Cost-Effective, and Green Fabrication and Detection Technologies


Electrochemical (EC) enzyme biosensors have emerged as vital tools across multiple societal domains, such as medical diagnostics, environmental surveillance, pharmaceutical analysis, and food safety testing. Their core working principle is rather simple and based on the ability of enzymes on electrode surfaces to specifically recognize nearby substrates - target analytesn - test solutions with sample and generate measurable electrical signals through efficient substrate conversion. Most prominent example of an EC enzyme biosensor is certainly the commercial blood glucose meter strip test, which revolutionized diabetes management by providing a convenient and reliable way for ill individuals to daily monitor blood glucose levels at home for personal health care. The vast number of publications over the past decades and the integration into numerous commercial test systems for various analytes are other proofs that modern EC enzyme biosensing indeed is a highly competitive analytical method, offering rapid, sensitive, and highly selective detection. However, despite of the attractiveness of EC enzyme biosensors for wide-ranging applications, the complexity inherent in traditional EC biosensor design and fabrication often limits their accessibility and hinders large-scale implementation. Accordingly, strategies to simplify the design of EC enzyme biosensors are of great interest, with the goal of refining their practicality, robustness, cost-effectiveness and ecofriendliness. Key tasks for modern biosensor R&D are the development of efficient enzyme immobilization methods that reduce procedural complexity, utilization of inexpensive and readily available sensor platforms such as screen-printed and laser-induced electrodes, minimization of chemical resources, and the creation of modular adaptable to various analytes, to name just a few. Additionally, an involvement of advanced microfabrication, automation and machine learning and artificial intelligence needs to be explored for their potential to aid the consistent assembly of miniaturized devices suitable for mass deployment.

This keynote presents own previous and ongoing work, including: (1) the only nanomaterialfree and thus resource and eco-friendly EC glucose biosensor with nanomolar detection capability; (2) any easy immobilization strategy for EC glucose biosensors featuring an exceptionally broad linear range; (3) the simplest established oxidase biosensor signal readout; and (4) a mass-producible, fully biodegradable (compostable) EC enzyme biosensor platform. The simplification and greening of EC enzyme biosensor tools and biosensing methodologies have been achieved and are now available for wider adoption in application-focused R&D. Ultimately, the strategies outlined aim to enhance bioanalysis and enable a more effective, affordable and ecologically aware monitoring of health, environmental conditions, pharmaceuticals, and food. An ongoing challenge is to get the balance right between simplicity and sustainability while still fulfilling the quality demands for real-world applications.

Professor (Dr) Albert Schulte/Professor (Dr) Wipa Suginta
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2nd International Conference on Applied Sciences

Sabaragamuwa University of Sri Lanka

ICAPS – SUSL 2026

Conference Track

Advances in Physical Sciences and Technologies for Future Sustainability

"Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future"

19th August 2026
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

Impact of Delivery Repetition (Machine Stability) on Gamma Passing Rates in IMRT QA

Kavinda K.G.D.[1*], Madushan P.A.S.[2], Wanigarathne M.S.[1], Kumari T.N.[2], Nawarathne H.M.C.J.[1], Ruvinda K.K.D.L.[2], and Fernando W.T.L.S.[1]

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Intensity Modulated Radiation Therapy (IMRT) is widely used in modern radiotherapy to deliver highly conformal doses to tumor volumes while minimizing exposure to surrounding healthy tissues. Because of the complexity of IMRT delivery, patient-specific quality assurance (PSQA) is essential to verify the accuracy of planned dose distributions. Gamma index analysis is a widely used method for validating IMRT dose delivery by comparing measured and planned dose distributions. It combines dose difference (DD) and distance-to-agreement (DTA) into a single evaluation metric, known as the gamma criterion. The primary aim of this study was to evaluate the reproducibility of gamma passing rates obtained from repeated IMRT patient-specific QA measurements and to assess LINAC machine stability using the clinically recommended 3%/2 mm gamma criterion. Unlike conventional IMRT QA studies that rely on a single pre-treatment measurement, this study evaluated the longitudinal reproducibility of repeated IMRT QA measurements as an indicator of machine stability. In this study, nine clinical IMRT treatment plans were delivered once per week over five consecutive weeks using an iMatriXX two-dimensional ionization chamber array detector system, and the measured dose distributions were analyzed using MyQA software. Gamma passing rates were recorded for each QA measurement, and descriptive statistical analysis and coefficient of variation (CV) were performed to evaluate the stability and variability of the results. The results showed that the overall mean gamma passing rate was 95.9 ± 3.17% and a coefficient of variation of 3.31%. This indicates good reproducibility of the measurements. Week-wise analysis showed moderate variability with coefficient of variation values ranging from approximately 2.2% to 5.1%. These findings indicate that repeated IMRT QA measurements using the 3%/2 mm gamma criterion provide acceptable reproducibility and support their use for longitudinal monitoring of LINAC machine stability in clinical radiotherapy.

Keywords: Gamma Criteria, Gamma Index, IMRT, Patient-Specific QA, Radiation Therapy

Assessment of Couch-Induced Attenuation in Photon Therapy Using Phantom Measurements

Koshila R.A.S.[1*], Madhushan P.A.S.[2], Dharmarathne Y.G.B.D.K.[2], Nawarathne H.M.C.J.[1], Wanigarathne M.S.[1], Ruvinda K.K.D.L.[2], and Fernando W.T.L.S.[1]

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Photon therapy includes modalities such as Three-Dimensional Conformal Radiation Therapy, Intensity Modulated Radiation Therapy (IMRT), and Volumetric Modulated Arc Therapy. IMRT was selected for this study as it uses multiple beam angles and modulated fields for precise dose distribution while minimizing dose to healthy tissues. Due to frequent posterior and oblique beam angles, radiation beams in IMRT often pass through the treatment couch, where couch attenuation can affect the delivered radiation dose. Patients are positioned on a carbon fiber treatment couch during IMRT delivery, valued for its mechanical strength and relatively low radiation attenuation compared to metallic couches. Although considered radiolucent, carbon fiber can still attenuate photon beams, particularly for posterior and oblique incidences. However, quantitative data on couch-induced attenuation specific to IMRT remain limited, particularly regarding its dosimetric impact when the couch is excluded from routine clinical planning. This study assessed couch-induced attenuation in photon therapy using phantom measurements. Thirty IMRT treatment plans were generated in the treatment planning system without incorporating the treatment couch model. Dose measurements were performed using a CIRS Model 036S End-to-End SBRT body phantom, an IBA CC30 cylindrical ionization chamber, and an IBA Dose1 electrometer. Measured doses were calculated and compared with treatment planning system calculations to determine the effect of couch attenuation on dose delivery accuracy. Statistical analysis was performed using the Wilcoxon signed-rank test to evaluate the observed dose differences. The mean absolute dose difference was found to be 0.0526 Gy (SD = 0.0345 Gy, 95% CI: 0.0397–0.0655 Gy), with a mean percentage difference of 2.47% (SD = 1.58%, range: 0.89%–4.05%). The Wilcoxon signed-rank test confirmed a statistically significant difference between the calculated and measured doses. These findings indicate that excluding the treatment couch from dose calculations may lead to a measurable underestimation of beam attenuation during IMRT photon therapy.

Keywords: Body Phantom, Couch Attenuation, IMRT, Ionization Chamber, Photon Therapy

Ultraviolet Spectroscopy of Classical Nova V838 Herculis During Outburst

Maduhansi P.A.I.[1], De Silva L.M.M.[1], Dharmathilaka J.A.D.M.[1], Tissera P.R.S.[1], Medagangoda N.I.[2], and Theekshana P.[2*]

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A classical nova is a sudden explosion occurring on the surface of a white dwarf in a binary star system due to thermonuclear runaway of material accreted from its companion star. The aim of this study is to distinguish the four main evolutionary phases during the nova outburst. Spectroscopic analysis was carried out for the classical nova system V838 Herculis (V838 Her) during the initial, pre-nebular, nebular and quiescent phases. Time series observations in the ultraviolet (UV) region were acquired using the International Ultraviolet Explorer (IUE) space telescope with Short Wavelength Prime (SWP) instrument over the wavelength range 1150–1975 Å. The spectra were dereddened to correct for interstellar extinction using CCM89 dust extinction model, and emission line profiles were analyzed using Gaussian profile fitting, focusing on O I λ1306, N III] λ1750, C III] λ1909 and [Ne IV] λ1602. The analysis indicates an ejecta velocity of 3600 ± 500 km s^{-1}. During the quiescent phase, the corresponding average UV luminosity was estimated as 6.31 ± 3.77 × 10^{34} erg s^{-1}, while the mass accretion rate was found to be 1.05 ± 0.67 × 10^{17} g s^{-1} for V838 Her. According to the theoretical model, V838 Her is classified as a ONe5/ONe6 nova with a white dwarf mass of approximately 1.30 ± 0.05 $M_{\odot}$. The evolution of the spectral lines suggests the boundaries of the different outburst phases based on the line profile analysis of O I λ1306, N III] λ1750, [Ne IV] λ1602, and C III] λ1909. The results demonstrate the significant role of white dwarf mass in governing the evolutionary progression of nova outbursts and provide an approximate identification of each evolutionary phase.

Keywords: Classical Nova, International Ultraviolet Explorer (IUE), Spectroscopic Analysis, V838 Herculis

A Spectroscopic Analysis of the Relationship between Mass Transfer Rate and Orbital Period in Cataclysmic Variable Stars

Sathya B.A.[1], De Silva L.M.M.[1], Dharmathilaka J.A.D.M.[1], Tissera P.R.S.[1], Medagangoda N.I.[2], Gunasekara S.S.[2], and Piyadasa D.B.T.L.S.[2*]

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Cataclysmic Variable (CV) stars are interacting binary systems in which a white dwarf accretes matter from a low-mass donor star through Roche lobe overflow. These systems play an important role in understanding accretion physics, binary star evolution, and orbital evolution in compact stellar systems. One of the key features in CV evolution is the orbital period gap (~2–3 hours), where a deficiency of systems is observed. This study investigates the relationship between mass transfer rate ($\dot{M}$) and orbital period (P) in CV systems through spectroscopic analysis, with the aim of examining how accretion behaviour varies with orbital evolution and CV subtype classification. A sample of 75 CV systems was analyzed using calibrated spectroscopic data obtained from the Sloan Digital Sky Survey (SDSS). Standard spectroscopic reduction techniques, including flux calibration, dereddening, continuum fitting, and Gaussian fitting of Balmer emission lines, were applied to extract spectral parameters. Flux ratios of Hγ/Hβ and Hδ/Hβ were used to estimate mass transfer rates and the mean temperatures of the accretion disks. The results reveal that the temperatures range from approximately 2,000 K to 10,000 K, with most systems clustering around ~6000 K. A strong positive correlation was identified between mass transfer rate and orbital period. The observed slopes of the log $\dot{M}$ – log P relation are approximately 1.96 for Hγ/Hβ and 1.85 for Hδ/Hβ, which are close to the theoretical value of 2 predicted by CV evolutionary models. Systems above the period gap exhibit significantly higher mass transfer rates than those below the gap. Variations in accretion behaviour were also observed among different CV subtypes, indicating the influence of both orbital evolution and accretion mechanisms on mass transfer processes. These findings support current theoretical models of CV evolution and demonstrate the importance of spectroscopic diagnostics in studying accretion behaviour in interacting binary systems.

Keywords: Cataclysmic Variable Stars, Mass Transfer Rate, Orbital Period, Period Gap, Spectroscopy

Investigation of Different Counter Electrodes in an Electrochromic Integrated Energy Storage Device

Dineshi B.L.P., Sanganayaka S.M.P.M.K., Egodawaththa E.G.O.D., and Sarangika H.N.M.*

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WO_3-based electrochromic devices (ECDs) have attracted significant attention due to their dual functionality in optical modulation and energy storage. ECDs are widely studied for smart windows, displays, and energy-saving optical devices because of their ability to reversibly control light transmission under an applied voltage. Recently, electrochromic devices have also gained attention for integrated battery applications, where both electrochromic and energy storage properties can be achieved within a single device. This study focused on investigating the effect of different counter electrodes on the performance of WO_3-based electrochromic batteries. WO_3 thin films were electrodeposited on fluorine-doped tin oxide (FTO) glass substrates using acidified sodium tungstate ($Na_2WO_4{\cdot}2H_2O$) solution at pH 1.2. The prepared WO_3 thin films were characterized using UV–Vis and FTIR spectroscopy. Electrochromic battery devices were fabricated using WO_3 as the working electrode, 3.0 M KCl as the electrolyte, and different counter electrodes including Pt, Zn, and stainless steel. The fabricated devices were first evaluated for electrochromic performance and later investigated for integrated battery applications. The WO_3 electrode exhibited in-situ blue coloration from an initially transparent state upon applying 2.5 V, and the coloration was completely reversible after removing the applied voltage. Among the tested counter electrodes, the Pt counter electrode showed superior electrochromic performance with the highest optical modulation of 82.27% at 785 nm and an optical density of 0.93. In comparison, the Zn counter electrode exhibited an optical modulation of 38.82% at 559 nm with an optical density of 0.27, while the stainless steel counter electrode showed an optical modulation of 9.43% at 799 nm with an optical density of 0.04. The device with the Pt counter electrode also exhibited coloration and bleaching times of 4.8 s and 2.0 s, respectively. Electrochemical analysis revealed reversible redox behavior and stable charge–discharge characteristics with an areal discharge capacity of 249 mAh m^{-2}. These results suggest that Pt is the most suitable counter electrode for integrated electrochromic battery applications.

Keywords: Discharge Capacity, Electrochromic Device, Electrodeposition, Energy Storage, Optical Modulation

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Chemical Sciences for Green Innovation and Sustainable Development

"Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future"

19th August 2026
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

Green Innovation for Sustainable Development: Biochar as a Sustainable Solution for Building Resilient Cities

It is with great pleasure that I extend my warm greetings to the organisers, participants, distinguished guests, and fellow researchers of the 2nd International Conference on Applied Sciences (ICAPS 2026), organised by the Sabaragamuwa University of Sri Lanka.

Today's global challenges demand solutions that transcend disciplinary boundaries. Issues such as environmental pollution, climate change, resource scarcity. Sustainable development requires collaborative research, innovative technologies, and strong partnerships between academia, industry, policymakers, and society. Conferences such as ICAPS provide an invaluable platform to exchange ideas, foster interdisciplinary collaborations, and inspire research that creates meaningful societal impact.

I sincerely commend the Organizing Committee of ICAPS 2026 for their dedication and commitment to promoting research and innovation. I congratulate all presenters and contributors for their valuable efforts and contributions to this scientific gathering.

I wish the 2nd International Conference on Applied Sciences (ICAPS 2026) every success and hope that the discussions, collaborations, and ideas generated during this conference will inspire innovative pathways towards a sustainable and resilient future.

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Comparative Antioxidant Activity of Sri Lankan Spice Essential Oils: A Study on Binary Essential Oil and Ascorbic Acid Combinations

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The antioxidant activities of hydro-distilled essential oils (EOs) from Sri Lankan spices Clove (*Syzygium aromaticum*; E1), Cinnamon (*Cinnamomum zeylanicum*; E2), Cumin (*Cuminum cyminum*; E3), Black cumin (*Nigella sativa*; E4), and Lemongrass (*Cymbopogon citratus*; E5) were assessed using the Ferric Reducing Antioxidant Power (FRAP) assay, highlighting the interaction effects of EOs in binary mixes and with ascorbic acid (A). EOs individually of low antioxidant activity showed strong positive interactions when blended: Black cumin + Lemongrass (E4+E5) being the strongest synergistic effect (+289.9%), followed by Cumin + Lemongrass (E3+E5, +78.7%) and Cumin + Black cumin (E3+E4, +58.7%). Conversely, blends with the presence of Clove (E1) and/or Cinnamon (E2) were strongly antagonistically suppressed (−89% to −98%), probably owing to the competitive effects of eugenol/cinnamaldehyde with other compounds. Addition of ascorbic acid consistently boosted the activity of low-activity EOs to produce moderate-antioxidant blends (3.45–4.35 g AAEq/L). Pre-formulation EO activities (clove: 58.74 ± 0.33, Cinnamon: 15.39 ± 1.16, Cumin: 0.84 ± 0.03, Black cumin: 0.54 ± 0.09, Lemongrass: 0.12 ± 0.04 g AAEq/L) were used as a baseline to calculate interactions. SAS ANOVA confirmed highly significant treatment effects ($F = 3647.43$, $p < 0.0001$, $R^2 = 0.9997$). Additionally, the optimal binary combination of Sri Lankan spice EOs (e.g., EO of Black cumin + EO of Lemongrass) has a synergistic antioxidant effect and can be used as natural preservatives in the food industry and as oxidative stress-relieving formulations in medicine. In contrast, blending high-phenolic Sri Lankan EOs (Clove/Cinnamon) is reduced because of antagonism. These results inform the development of EO blends for phytotoxicant applications in food preservatives and medications.

Keywords: Antioxidant Activity, Binary Combinations, Essential Oils, FRAP Assay, Sri Lankan Spices

Role of EDTA in the Photophysical Enhancement of a Luminescence Material Derived from Butterfly Pea (*Clitoria ternatea*) Dye

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The development of sustainable natural precursor materials for optoelectronic and bioimaging applications has gained significant attention due to their low cost, abundance, and non-toxicity. In this study, anthocyanin-rich extract from Sri Lankan *Clitoria ternatea* (butterfly pea) flower petals (BFPP) was utilized as a luminescent-active material via hydrothermal treatment. A comparative study was made between the hydrothermally-treated sample (HS) and the EDTA-assisted hydrothermally-treated sample (HS-EDTA) in order to elucidate the evolution of photophysical properties. UV–Vis absorption spectra of HS and HS-EDTA showed broadening of peaks, suggesting the formation of carbonized regions, with the intensity of HS-EDTA being higher than that of HS. The photoluminescence peak of HS-EDTA was more intense but narrower than that of HS under 270 nm excitation, indicating the formation of a blue-luminescence active material. A noticeable Stokes shift of HS-EDTA (88 nm) compared to HS (83 nm) implies significant energy relaxation through surface states. The longer average lifetime and altered decay components in HS-EDTA suggest the formation of stabilized surface emissive states and reduced non-radiative recombination through EDTA-assisted passivation. Furthermore, the addition of EDTA increased the photoluminescence quantum yield (PLQY) by 0.6%. The co-existence of a larger Stokes shift and enhanced PLQY in HS-EDTA further confirms that EDTA-induced surface engineering creates radiative centers attributed to improved surface passivation by suppressing non-radiative recombination. Overall, this work has successfully shown the synthesis of a functional luminescence material from BFPP and the enhancement of photophysical properties, as well as surface engineering by EDTA, on the synthesized luminescence material suitable for future optoelectronic device applications.

Keywords: Hydrothermal, Optoelectronic, Photoluminescence, Photophysical Enhancement, Surface Passivation

Microbiological Study of Cosmetic Products during their Use by Consumers

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Cosmetics, including shampoos, need not be sterile but must be free from pathogenic microorganisms and maintain low microbial counts to ensure product quality and consumer safety. As surfactant-rich tensiolytes, shampoos provide a favorable environment for microbial proliferation due to their high water and nutrient content, making them susceptible to contamination during manufacturing, storage, and consumer use, especially under warm and humid conditions. This study evaluated the microbial quality of two commercially available herbal shampoos manufactured in Sri Lanka across three stages: intact, in-use, and end-use. Product 01 contained parabens as a preservative along with natural ingredients, while Product 02 was formulated from herbal components without preservatives. Microbial enumeration was performed using Tryptone Soy Agar (TSA) for bacteria, incubated at 37°C for 24–48 hours and Potato Dextrose Agar (PDA) for fungi, incubated at 25°C for 3–5 days. Isolates were identified by morphological and biochemical methods. Screening for key pathogens *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* spp. was conducted using selective media. Results showed that Product 01 maintained consistently low microbial counts across all stages with no pathogenic bacteria detected. Only two bacterial isolates belonging to the Micrococcaceae family at the end-use stage and two fungal isolates from Mucoraceae family and *Penicillium* sp. were recovered. In contrast, Product 02 exhibited approximately five-fold higher bacterial counts and substantial fungal growth. Bacterial isolates included *Staphylococcus* spp., *Listeria* spp., *Corynebacterium* sp., *Staphylococcus simulans*, *Lactobacillus acidophilus*, and *Pseudomonas aeruginosa* were detected at the in-use stage. Fungal isolates included *Penicillium* sp., *Rhizopus* spp., and *Aspergillus* sp. These findings highlighted the increased microbial risk associated with preservative-free herbal cosmetic formulations and emphasized the critical role of effective preservative systems in controlling contaminations in tensiolytes.

Keywords: Cosmetics, Herbal Shampoo, Microbial Contamination, Preservatives, Tensiolytes

Biogenic Nanofabrication of Silver Nanoparticles Utilizing *Jeffreycia zeylanica*: A Green Chemistry Approach Toward Sustainable Antibacterial Therapeutics

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Green nanotechnology offers sustainable alternatives to traditional chemical synthesis methods, particularly in the development of antimicrobial agents. *Jeffreycia zeylanica* is a medicinal plant species in the Asteraceae family, native to Sri Lanka and surrounding regions. The unexplored bio-reductive potential of the endemic *Jeffreycia zeylanica* represents a critical gap in the fabrication of sustainable antimicrobial nanoparticles. This study focuses on the green synthesis of silver nanoparticles (AgNPs) using aqueous leaf extract of *Jeffreycia zeylanica*. The aim was to synthesize, characterize, and evaluate the antibacterial activity of plant-mediated AgNPs. AgNPs were synthesized by reacting the aqueous extract with 10 mM silver nitrate in both 1:2 and 1:4 ratios. The formation of nanoparticles was confirmed by a visible color transition from pale yellow to dark grey, and UV–Visible spectroscopy revealed characteristic Surface Plasmon Resonance (SPR) peaks at 404 nm and 405 nm, indicating the formation of predominantly spherical AgNPs. X-ray diffraction (XRD) analysis confirmed the crystalline nature of the nanoparticles with a face-centered cubic (FCC) crystalline structure, with diffraction peaks corresponding to the (111), (200), (220), and (311) planes. In vitro antibacterial assays using the well diffusion method demonstrated that the 1:4 synthesized AgNPs inhibited the growth of *Staphylococcus aureus* (9.6 ± 1.5 mm) and *Escherichia coli* (3.3 ± 5.7 mm). Similarly, the 1:2 ratio yielded inhibition zones of 6.3 ± 5.5 mm against *S. aureus* and 3.6 ± 6.3 mm against *E. coli*. According to these results, AgNPs exhibited significant antibacterial activity against both bacterial strains, although the inhibition zones were smaller than those of silver nitrate due to slower diffusion and controlled release of silver ions. Overall, the study highlights the potential of *J. zeylanica*-mediated AgNPs as eco-friendly and effective antibacterial agents with sustained activity, supporting their application in green chemistry and biomedical fields.

Keywords: Antibacterial Activity, Green Synthesis, Inhibition, *Jeffreycia zeylanica*, Silver Nanoparticles

Synthesis of Zeolite-A from Rice Husk Ash for Adsorptive Removal of Methylene Blue from Wastewater

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The contamination of water resources by synthetic dyes released from textile and industrial effluents poses a significant environmental concern, as these compounds are largely toxic, non-biodegradable, and resistant to conventional treatment methods. Adsorption has emerged as a particularly attractive remediation strategy due to its operational simplicity, high efficiency, and adaptability to a wide range of pollutants. This study presents the synthesis of Zeolite-A from rice husk ash (RHA), a low-cost and abundantly available silica-rich agricultural by-product, and evaluates its potential for the adsorptive removal of Methylene Blue (MB), a model cationic dye, from contaminated wastewater. Rice husk was subjected to controlled calcination to yield RHA, which served as the sole silica source in a hydrothermal synthesis process based on standard methods. Successful formation of Zeolite-A was confirmed using Fourier Transform Infrared Spectroscopy (FTIR) characterization, which revealed characteristic spectral features including double-ring vibrations (~559 cm^{-1}), T–O bending (~666 cm^{-1}), and asymmetric framework stretching (~977 cm^{-1}), all consistent with the Linde Type A (LTA) aluminosilicate framework. Batch adsorption experiments were conducted to systematically investigate the effects of adsorbent dosage, contact time, initial MB concentration, and solution pH on the efficiency of MB removal. Under optimum conditions of 0.100 g adsorbent dosage, pH 7, and 30 min contact time, the synthesized Zeolite-A achieved approximately 71% removal efficiency for a 6 ppm MB solution. Adsorption performance increased with increasing adsorbent dosage and reached equilibrium within 30 minutes. These results demonstrate that rice husk-derived Zeolite-A is an efficient, sustainable, and low-cost adsorbent for dye-contaminated wastewater treatment while providing an environmentally beneficial approach for valorizing agricultural waste.

Keywords: Adsorption, Methylene Blue, Rice Husk Ash, Wastewater Treatment, Zeolite-A

Synthesis and Application of a Sodium-Activated Rice Husk Ash (Na-RHA) Catalyst for Biodiesel Production

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The growing demand for sustainable energy has driven the exploration of biodiesel as an alternative fuel. This study investigates the synthesis and application of a sodium-activated rice husk ash (Na-RHA) catalyst as a low-cost heterogeneous catalyst for biodiesel production. Rice husk (*Oryza sativa* L.), an abundant agricultural waste rich in silica (SiO_2), was used as the precursor. The rice husk was washed, dried, and calcined at 700 °C for 3 hours to obtain silica-rich rice husk ash (RHA), followed by chemical activation with 1 M sodium hydroxide (NaOH). Fresh refined coconut oil (50 g) was preheated to 60 °C to remove moisture, and transesterification was carried out using a methanol-to-oil molar ratio of 6:1 at 60 °C and 600 rpm for 2 hours. Catalyst loading was varied from 0.5 g to 2.0 g (1–4 wt%) to determine the optimum dosage. The highest biodiesel yield of 81.14% was obtained at 2 wt% catalyst loading (1.0 g), while higher catalyst dosages reduced the yield due to increased viscosity, mass-transfer limitations, and saponification. After the reaction, the catalyst was separated by filtration, and the biodiesel and glycerol phases were allowed to separate before biodiesel recovery. FTIR analysis revealed the removal of organic functional groups after calcination, and the presence of characteristic silica bands at 1034 cm^{-1} and 788 cm^{-1}. The shift of the main silicate band to 1001 cm^{-1} after NaOH activation indicated sodium-modified surface sites. The reused catalyst exhibited similar silica-related bands with a minor peak near 1446 cm^{-1} attributed to carbonate formation, suggesting partial deactivation. Although the Na-RHA catalyst produced a lower biodiesel yield than conventional homogeneous NaOH catalysts, it demonstrated advantages including easy catalyst recovery and potential reusability. Further studies involving GC–MS, fuel property analysis, SEM, and XRD are recommended to confirm biodiesel quality and further characterize the catalyst.

Keywords: Biodiesel, Heterogeneous Catalyst, Na-RHA, Rice Husk (*Oryza sativa* L.), Transesterification

2nd International Conference on Applied Sciences

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ICAPS – SUSL 2026

Conference Track

Digital Innovation and Intelligent Technologies for Sustainable Societies

"Advancing Multidisciplinary Research and Innovation for a Sustainable and Resilient Future"

19th August 2026
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

The Next Digital Revolution - Research, Artificial Intelligence, and Building a Future-Ready Workforce

Technology is evolving at an incredible pace, transforming industries, workplaces, learning, and society. Artificial intelligence, generative AI, cloud computing, data analytics, cybersecurity, automation, robotics, and emerging digital technologies are rapidly reshaping how we work, learn, conduct research, and solve complex problems.

This presentation explores the current technology and industry landscape and examines how these developments are likely to influence the workforce and society in the years ahead. It highlights the growing importance of AI-enabled research, multidisciplinary collaboration, responsible innovation, cybersecurity, sustainability, and human-centric technologies.

Special emphasis is placed on the evolving job market and the new possibilities that are coming from the digital revolution. Instead of seeing technological advancement as a threat to employment, the presentation emphasizes the need to prepare individuals and organizations for a changing world through continuous learning, upskilling, reskilling, industry certifications, practical experience, research, and stronger collaboration between universities and industries.

This presentation also emphasizes that the challenges of the future cannot be addressed by a single discipline. Meaningful innovation will increasingly emerge at the intersection of computer science, engineering, business, healthcare, environmental sciences, social sciences, and other fields.

Ultimately, the future will belong not simply to those who possess technological knowledge, but to those who can continuously learn, adapt, collaborate, innovate, and apply knowledge responsibly. By connecting research with real-world challenges and equipping the next generation with both technical and human capabilities, we can transform technological advancement into sustainable opportunity and build a more resilient and inclusive future.

Mr Pradeep Pushpakumara
Director/CEO
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Classification of Bug Environments in Software Bug Reports Using Deep Learning Models

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In recent decades, software usage has become highly demanding in every field. Every piece of software can have its own errors and crashes, called bugs, due to various reasons. Because of this, there is a role called Software Quality Assurance (SQA), which helps to find bugs in different software systems. Finding bugs in software is referred to as debugging. Bugs can occur in different environments. There are three main environments: Development, Staging, and Production. The bug environment is very important for determining the bug priority level, severity level, and bug triage, which are currently handled manually. To assist debuggers, this paper proposes a model with the objective of automatically predicting the bug environment based on the bug report description using deep learning techniques. For this purpose, 21,000 bug reports from Bugzilla across Firefox, Eclipse, NetBeans, and OpenOffice were used. To obtain the bug environment for each report, they were labeled with the assistance of an SQA engineer. After preprocessing the textual data to obtain numerical values, features were extracted using Term Frequency-Inverse Document Frequency (TF-IDF) and Word2Vec. Five models, namely Artificial Neural Network (ANN), Long Short-Term Memory (LSTM), Bidirectional LSTM (Bi-LSTM), Convolutional Neural Network (CNN), and Extreme Gradient Boosting (XGBoost), were implemented. Experimental results show that TF-IDF significantly outperformed Word2Vec for this task. Among the individual models, LSTM achieved the highest accuracy of 90.64%. And also, precision, recall, and f-measure, error values outperform all individual classifiers. ANN, Bi-LSTM, XGBoost, and CNN followed as the next best models, respectively. The proposed model offers a practical solution to reduce human error and improve efficiency in software quality assurance workflows. Future work will involve gathering bug reports from sources other than Bugzilla and considering additional deep learning models, including ensemble approaches.

Keywords: Bug Environment, Deep Learning, Ensemble Learning, LSTM, Prediction

Enhanced Command-Line Tools Using Large Language Model Integration and Shell Assistance

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Command-Line Interface (CLI) tools are predominantly characterized by their speed, accuracy, and adaptability across research and developer communities. However, their limited real-time guidance and visual feedback can present substantial challenges for novice users. Therefore, this study aims to improve user interaction in command prompt applications compared with traditional command-line interfaces. Common CLI difficulties were identified through a survey of 50 computer science undergraduates. Drawing on recent research in LLM-based terminal assistance and reasoning-driven tool use, this terminal was developed through iterative analysis, design, implementation, and testing. The proposed terminal integrates intelligent command suggestions, real-time syntax highlighting, and AI chatbot assistance through five modules: a command parser, suggestion engine, syntax highlighter, AI chatbot, and history and preferences handler. The suggestion engine was decoupled from the chatbot for independent testing and extensibility, and Rust was chosen for memory safety and performance. The intelligent code recommendation engine improves operational efficiency and reduces syntax errors by predicting and auto-completing commands during user input. Real-time syntax highlighting facilitates rapid error identification and improves command understandability. Acting as a real-time help system housed within the terminal, the AI assistant provides explanations, user examples, and support for a broader spectrum of commands. These developments guarantee a lightweight, more secure, and cross-platform portable application through the Tauri framework and Rust programming language. The developed terminal provides a smart, more intuitive, and inclusive CLI experience for users of all levels, aligning with the growing adoption of intelligent developer tools. Future work includes third-party plugin support, voice recognition, secure cross-device synchronization, and real-time multi-user collaboration.

Keywords: AI Chatbot, CLI Enhancement, Command Prompt, Intelligent Suggestions

Determinants of AI Adoption in Full-Stack Development in Sri Lanka's Software Industry

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The rapid advancement of Artificial Intelligence (AI) has transformed software engineering practices, making full-stack development an essential capability for implementing end-to-end AI solutions. However, AI integration in Sri Lanka's software industry remains limited due to challenges in technological infrastructure, leadership support, AI competencies, and organizational readiness. Although previous studies have explored AI adoption in general organizational settings, limited empirical evidence exists regarding the technological, organizational, and individual factors influencing AI adoption in full-stack development within Sri Lanka. Therefore, this study investigates the determinants of AI adoption among software professionals engaged in full-stack development. A quantitative research design was employed using a structured five-point Likert scale questionnaire validated through expert review and pilot testing. Data were collected from 15 ICT firms selected through purposive sampling, while 423 software professionals, including software developers, QA engineers, technical leads, and other IT practitioners, were selected using convenience sampling. Data were analyzed using descriptive statistics, reliability analysis, correlation analysis, and hierarchical multiple regression in SPSS. The final regression model explained a substantial proportion of the variance in AI adoption ($R^2 = 0.668$; Adjusted $R^2 = 0.655$; $p < 0.001$). System compatibility ($\beta = 0.240$, $p < 0.001$) and top management support ($\beta = 0.246$, $p < 0.001$) emerged as the strongest predictors, while infrastructure readiness, AI skills and technical expertise, and trust in AI tools also showed significant positive effects. In contrast, security and privacy, financial readiness, training and human capital development, and openness to change were not statistically significant ($p > 0.05$). The findings highlight that successful AI adoption in full-stack development depends on technological readiness, organizational commitment, and individual capability. Accordingly, this study proposes a statistically validated multi-level AI adoption framework to support software companies and policymakers in strengthening AI-driven full-stack development in Sri Lanka.

Keywords: AI Adoption, Full-Stack Development, Organizational Capability, Sri Lanka Software Industry, Technological Readiness

Machine Learning-Based Early Warning System for Predicting Academic Risk in Sri Lankan G.C.E. Advanced Level Students

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Predicting student academic performance is critical in modern educational systems, particularly for the early identification of students at risk of failing key examinations. In Sri Lanka, the G.C.E. Advanced Level (A/L) examination plays a decisive role in determining access to higher education, yet traditional evaluation methods often fail to provide timely warnings. To address this gap, this study proposes a machine learning-based early warning framework integrated with an interactive web dashboard to identify at-risk students and support timely pedagogical interventions. The dataset comprises records of 900 Grade 12 students from government schools in the Matara District, incorporating 24 variables spanning academic history, attendance, behavioral traits, and socioeconomic factors. A binary classification approach was adopted, categorizing students into "At-Risk" and "At-Safe" classes. Twelve machine learning algorithms were compared: Decision Tree, Random Forest, XGBoost, Gradient Boosting, Support Vector Machine, K-Nearest Neighbors, CatBoost, Artificial Neural Network, LightGBM, Bagging, AdaBoost, and Logistic Regression. Models were trained using a 70% training split with 10-fold stratified cross-validation for hyperparameter tuning, and evaluated on a 30% test set. Ensemble-based models demonstrated superior performance; Random Forest achieved the highest overall predictive accuracy at 92.59%, with a precision of 91.57%, recall of 96.20%, F1-score of 93.83%, and ROC-AUC of 0.9791. XGBoost performed competitively, achieving 91.85% accuracy and an F1-score of 93.13%. Feature importance analysis identified first-term marks (36.37%) and second-term marks (30.28%) as the primary predictors. Utilizing the top-performing Random Forest model, a functional Early Warning System (EWS) prototype was developed using the Streamlit web framework, providing educators with real-time risk predictions and actionable student profile insights.

Keywords: Classification, Early Warning System (EWS), G.C.E. Advanced Level, Machine Learning, Student Performance

Real-Time Risk Prediction in IT Projects Using Streaming Machine Learning

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Budget overruns and schedule delays remain pervasive in IT projects. Conventional risk management relies on periodic assessments and rigid frameworks that lack the responsiveness to address emerging issues in time. Despite the availability of rich project activity data, most risk prediction approaches still rely on static batch-learning models that fail to capture evolving project dynamics. Few studies have empirically compared streaming and batch models under real project conditions, leaving their relative effectiveness unclear. Thus, this study presents a streaming machine learning framework for real-time IT project risk prediction, drawing on the Apache JIRA Issues dataset of 960,000 issues and five million comments spanning multiple open-source projects and repositories. Project risk was operationally defined as the probability of schedule delays or budget overruns. Three incremental learning algorithms were evaluated: Hoeffding Trees, Adaptive Random Forests (ARF), and ADWIN Bagging Ensemble, each capable of learning continuously without storing all past data. ADWIN-based concept drift detection keeps models aligned as project conditions shift, while risk signals such as unresolved issue buildup, escalating ticket patterns, and blocked dependencies are extracted from live data streams. All models were assessed via a prequential protocol against batch classifiers. The LightGBM batch baseline model achieved a ROC-AUC of 0.9938 and an F1-score of 0.9421. In comparison, the leading streaming model, ADWIN Bagging model, attained a ROC-AUC of 0.9896 and an F1-score of 0.9398 after a single pass through the live data. It also maintained a low false-positive rate of 1.3%, suggesting minimal alert fatigue. Feature-importance analysis identified comment density as the most influential predictor, and performance remained consistent across different project types. This research presents an adaptive approach that supports the transition from reactive to proactive risk management. Future work will evaluate its practical applicability in industrial settings.

Keywords: Adaptive Ensemble Learning, Concept Drift Detection, Incremental Learning, Project Risk Management, Streaming Machine Learning

Automated Detection of Unsafe Banana Ripening Practices using Deep Learning

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Bananas (*Musa* spp.), among the world's earliest cultivated fruits and a major agricultural crop in Sri Lanka, contribute substantially to food security and human nutrition. However, unsafe and non-standardized chemical ripening practices may compromise fruit quality and pose potential risks to consumer health. This study investigates deep learning-based image classification methods to distinguish proper and improper chemical ripening practices in two Sri Lankan banana varieties, Ambul (Sour Banana) and Seeni (Sugar Banana), treated with ethephon under both controlled standard and non-standard ripening conditions. A dataset of 1,457 images was developed through controlled and non-standard ripening treatments, followed by preprocessing and augmentation. EfficientNet-B2 achieved the highest performance, obtaining test accuracies of 99.11% for Ambul and 99.04% for Seeni on the held-out test set. The selected model was integrated into a Flask-based application programming interface and deployed through a mobile-responsive web application supporting English, Sinhala, and Tamil for real-time classification. Future work will focus on validating the proposed system using larger and more diverse datasets collected under real-world ripening and environmental conditions.

Keywords: Banana Ripening, Deep Learning, EfficientNet-B2, Ethephon, Image Classification

AI Powered Cinnamon Grade Classification using Deep Learning and Computer Vision

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Ceylon cinnamon (*Cinnamomum verum*) is a high-value agricultural export of Sri Lanka, where accurate grade classification is essential for quality assurance and international market acceptance. Conventional grading relies on subjective visual assessment, leading to inconsistencies in classification. This research proposes an automated deep learning-based classification system for four commercially significant Ceylon cinnamon quill grades Alba, C4, C5, and C5 Special based on SLS 81:2021 standards. A dataset of 1,541 labelled images was developed by combining 620 self-collected multi-view images, captured from five viewing angles per quill, with 921 publicly available images. The dataset contains 423 Alba, 310 C4, 314 C5, and 494 C5 Special images and was stratified into training (70%), validation (15%), and testing (15%) subsets. Seven transfer learning architectures DenseNet121, ResNet50V2, DenseNet201, InceptionV3, EfficientNetB0, Xception, and MobileNetV2 were systematically evaluated. DenseNet121 achieved the highest individual accuracy of 90.60%, followed by ResNet50V2 (89.74%) and DenseNet201 (88.46%). A soft-voting ensemble of these top three models achieved 95.82% accuracy and a macro F1-score of 0.965. Confusion analysis identified C4–C5 as the primary challenging grade pair, while Grad-CAM analysis demonstrated that model predictions were primarily influenced by relevant quill surface texture and structural characteristics. A mobile-based inference pipeline is currently under development, integrating image quality assessment, multi-quill detection, on-device ensemble classification, optional diameter verification, and decision fusion. This research contributes an SLS 81:2021-referenced cinnamon image dataset, systematic transfer learning evaluation, an interpretable ensemble classification approach, and a foundation for mobile deployable automated cinnamon quality grading.

Keywords: Ceylon Cinnamon, *Cinnamomum verum*, CNN, Deep Learning, Ensemble Learning

Edge-AI Based Smart Security System Using TinyML on ESP32-CAM for Real-Time Access Control

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Smart security systems have become an essential component of modern IoT applications; however, many existing access control solutions depend on cloud computing for image processing, leading to increased response time, network dependency, and privacy concerns. Running machine learning models directly on embedded devices remains challenging because of limited memory and processing capabilities. This work presents an Edge-AI-based access control system that performs real-time facial recognition on an ESP32-CAM using TinyML. A lightweight Convolutional Neural Network (CNN) was developed with the Edge Impulse platform and deployed on the microcontroller after model optimization. The recognition model was developed using a custom dataset of 2,782 facial images, comprising 757 images of authorized users (400 male and 357 female) and 2,025 images of unknown individuals. The images were captured under varying lighting conditions and viewing angles to improve the model's robustness in real-world environments. The trained TinyML model was integrated into the ESP32-CAM, enabling on-device face recognition without external processing. When a face is detected, the system immediately determines whether the individual is authorized and executes the corresponding access control action, while the current detection status is displayed through a web-based monitoring interface. Performance evaluation was conducted using the complete ESP32-CAM prototype under varying lighting conditions and viewing angles with both authorized and unknown individuals during real-time face recognition. Testing of the complete prototype recorded an overall classification accuracy of 96.5%, with the ESP32-CAM performing face recognition continuously in real time despite its limited processing power and memory. The results confirm that accurate access control can be achieved using a low-cost embedded platform while keeping image processing entirely on the device, reducing network dependency and helping to preserve user privacy.

Keywords: Edge-AI, ESP32-CAM, IoT, Smart Security System, TinyML

TeaLink: A Mobile Platform for Digital Tea Harvest Management in Sri Lanka

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Sri Lanka's tea industry relies heavily on smallholder estates, most of which still use handwritten harvest and payment records, causing data errors, disputes, and limited visibility. TeaLink digitizes tea collection to provide an accurate, transparent, efficient system from field to factory. Requirements were gathered through interviews with tea factory owners on record-keeping and payment issues. Built with Flutter and Firebase Firestore under an Agile approach, TeaLink offers real-time GPS-verified harvest logging, automatic weight calculations, and role-based dashboards for collectors, landowners, and administrators, with a bilingual Sinhala-English interface. An anomaly detection feature checks each weight entry against expected ranges, flagging unusual values so administrators can spot possible errors or fraud before payment. The system underwent functional testing to confirm features worked correctly. The completed platform delivers all planned features in a fully functional, field-ready application. GPS logging accurately verifies collection locations, anomaly detection correctly flagged out-of-range entries during testing, and the bilingual interface and dashboards performed as intended. Real-world user evaluation is planned next. TeaLink can reduce data entry errors, improve payment transparency, and give owners real-time access to harvest information, easing disputes common to paper-based recording, while building records that may support future sustainability certification and export access. TeaLink is the first mobile platform tailored to Sri Lanka's smallholder tea supply chain, combining Sinhala support, role-based access, offline recording, and GPS-verified logging in one field-ready application. Planned enhancements include IoT weighing and ML forecasting, with blockchain traceability as a future direction.

Keywords: Agricultural Analytics, Digital Agriculture, GPS Tracking, Mobile Application, Sustainable Harvesting

A Machine Learning Approach for Recommending Suitable Technology Stacks Based on Project Characteristics

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Selecting an appropriate technology stack is one of the most consequential decisions in software development, directly influencing a project's performance, scalability, security, and long-term maintainability. Despite its significance, this decision continues to rely heavily on developer experience and personal preference rather than evidence-based analysis, often resulting in poor architectural choices, increased technical debt, and project failure. This research proposes and evaluates a machine learning-based recommendation system that predicts suitable frontend frameworks, backend technologies, and database systems from project characteristics. A dataset of 4,850 real-world software projects was compiled from GitHub repositories and collaborating software companies across ten application domains, including e-commerce, healthcare, education, finance, social media, logistics, real estate, human resources and recruitment, IoT and smart systems, and travel and hospitality. Following systematic data cleaning, 4,437 valid records were retained. Exploratory analysis showed that project domain and primary programming language are the strongest predictors of technology stack selection, with language-to-backend mappings reaching 100% consistency in five cases. Feature engineering produced a 394-dimensional input vector combining ordinal encoding, one-hot encoding, and TF-IDF vectorization of functional and non-functional requirement text. Five machine learning approaches were evaluated: classifier-chain XGBoost, classifier-chain CatBoost, LightGBM, a NoBERT model (combining frozen Sentence Transformer embeddings with a LightGBM classifier), and a stacking ensemble integrating XGBoost, CatBoost, LightGBM, and NoBERT. The classifier-chain XGBoost model achieved the strongest performance, with frontend accuracy of 76.6%, backend accuracy of 71.6%, and database accuracy of 80.0%, an average of 76.1%, substantially exceeding a majority-class baseline. A functional prototype web application, developed using Flask, allows practitioners to enter project requirements and receive ranked technology recommendations together with confidence scores and feature-based explanations. The findings demonstrate that data-driven methods can meaningfully support technology stack decisions, reducing subjectivity and improving consistency in early-stage software planning.

Keywords: Feature Engineering, Machine Learning, Recommendation System, Software Engineering, Technology Stack Selection

Reinforcement Learning Approach for Requirements Engineering with Multi Agents

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Requirements Engineering (RE) defects cost ten to one hundred times more to correct after deployment than during the RE phase. LLM-based multi-agent frameworks now automate substantial portions of the RE pipeline, but every existing system executes its agents in a fixed sequence regardless of project state, a structural limitation since RE is a sequential decision problem where the optimal action depends on what has already been established. This study proposes a reinforcement learning (RL) approach in which a Proximal Policy Optimization (PPO) policy learns context-sensitive action selection within a multi-agent RE pipeline. With our knowledge, this is the first study applying RL to agent action selection in a multi-agent RE pipeline, evaluated using RESimEnv, the first Gymnasium-compatible RL benchmark for RE, comprising 55 scenario templates across 18 domains. The policy observes a 1544-dimensional embedding of the shared workspace and selects among four actions: proposing questions, drafting, refining, or flagging missing coverage. Reward weights follow established defect-cost ordering; a sensitivity analysis across alternative weightings is left for future work. The policy is evaluated against a fixed-pipeline baseline on 22 paired episodes, satisfying an a priori power analysis of 80% power. The trained policy significantly outperforms the baseline on total oracle reward (Cohen's $d = 1.361$, $p < 0.0001$, corroborated by the Wilcoxon test and bootstrap confidence intervals), driven by a large gain in requirement precision (0.183 to 0.453, +147%, $d = 2.12$), with coverage fully preserved. Extended training diagnostics are planned for future work. Orchestration strategy, not only the language generation performed by agents, can be learned from outcome-based feedback rather than hand-coded rules; the policy reduces unsupported or fabricated requirement content without any explicit rule against fabrication, suggesting reward-based training can induce analyst-like behavior practitioners would otherwise need to encode manually.

Keywords: IEEE 830, LLM, Multi-Agent Systems, Reinforcement Learning, Requirements Engineering

Development of an AI-Based Application for Landslide and Flood Prediction in Sri Lanka

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This research presents an autonomous Reinforcement Learning (RL)-based multi-hazard prediction framework integrated into a web application for monitoring rainfall and identifying areas in Sri Lanka that are vulnerable to floods and landslides. The study was motivated by the limitations observed in traditional disaster warning systems, particularly during the 2025 Cyclone Ditwah emergency, when delays and structural weaknesses affected the delivery of timely alerts. Existing prediction approaches commonly use supervised learning algorithms, such as Random Forest and Decision Tree models, to classify hazard levels using rainfall, soil saturation, and geographical factors. However, these models are often static and may not respond effectively to rapidly changing environmental conditions. To address this limitation, the proposed framework applies Reinforcement Learning to support adaptive and continuously improving hazard prediction. The model was designed to consider the geographical and climatic diversity of Sri Lanka and to update its decisions through environmental feedback. A multi-source dataset containing 1,500 records was obtained from the Department of Meteorology of Sri Lanka. The dataset included rainfall measurements and other conditioning factors related to flood and landslide occurrence. Eighty percent of the data was used to train the model, while the remaining twenty percent was used for testing. The developed model achieved a prediction accuracy of 75.14% across the selected multi-hazard classification scenarios. It was then integrated into a web-based interface that allows users to select a region and modify relevant conditioning factors. Based on these inputs, the system estimates the probability of a flood or landslide and provides an alert indicating the potential hazard level in the selected area. The proposed system can support timely decision-making, disaster preparedness, and early warning activities in Sri Lanka.

Keywords: AI Disaster Prediction, Cyclone Ditwah, Flood Forecasting, Landslide Analysis, Reinforcement Learning

Mental Health Status Prediction Using Machine Learning on Textual Data

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Mental health disorders such as depression, anxiety, stress, bipolar disorder, personality disorder and suicidal tendency have become more frequent worldwide, thus creating the need for reliable and accessible early detection methods. The goal of the research is to develop an interpretable Machine Learning model that can predict multiple mental health conditions from text and address the shortcomings of existing binary sentiment classification approaches. The proposed methodology is based on a Decision Tree classifier trained on the Sentiment Analysis for Mental Health dataset from Kaggle with 53,043 labeled text statements collected from Reddit, Twitter, chatbot conversations and other social media platforms. The dataset contains 7 classes including Normal, Depression, Suicidal, Anxiety, Stress, Bipolar and Personality Disorder. Standard NLP techniques such as text preprocessing and vectorization were used. Class imbalance was dealt with using the Synthetic Minority Over-sampling Technique (SMOTE). The Decision Tree classifier achieved a training accuracy of 0.999 and testing accuracy of 0.668. The model was able to learn the pattern from the training data but the difference between training and testing is quite high indicating overfitting and less generalization on unseen data. Results show that the proposed model provides an interpretable baseline for multi-class mental health prediction but needs further optimization to improve its generalization performance. The results suggest that interpretable Machine Learning techniques can be employed for preliminary mental health screening from textual input. Future work might involve optimizing the model and hyperparameters, enhancing feature engineering, using ensemble learning, or employing more robust algorithms to mitigate overfitting and boost predictive performance and real-world usefulness. Most of the existing research mainly addresses binary sentiment classification or computationally expensive deep learning models. This study proposes a lightweight and interpretable Decision Tree-based approach for multi-class prediction of mental health conditions using textual data, which can be used as a practical starting point for further research on explainable mental health prediction systems.

Keywords: Decision Tree, Machine Learning, Mental Health, Natural Language Processing, Text Classification

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Earth System Science and Environmental Resilience

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Conservation in Larger Landscapes and Seascapes: A Biogeographical Perspective

Being a first batch alumnus of the Department of Natural Resources of the Sabaragamuwa University, and after teaching in the same department for 20 years before taking up my current position at IUCN (International Union for Conservation of Nature), I am very happy and honoured for being invited to speak in front of this forum of fresh to senior Applied Scientists of Sri Lanka, at the second ICAPS in the beautiful Sabaragamuwa University, which I call the Montane University of Sri Lanka. Today my talk is of course on my favourite discipline of Environmental Conservation - a truly Applied Science – where I would bring biogeographical perspectives into conservation planning. The talk is on Conservation in Larger Landscapes and Seascapes. Most of you must be well-aware that we in Sri Lanka share a biodiversity hotspot with the Western Ghats of India. Among the 37 global biodiversity hotspots recognised so far, the Western Ghats and Sri Lanka have been recognised for its exceptional diversity and endemism of flowering plants, reptiles, amphibians and some groups of invertebrates such as freshwater crabs. How best this fascinating evolutionary marvel be conserved has always been my quest in Science, which made me pursue my doctoral studies in South Africa on Conservation Biogeography – the discipline that brings a wholistic picture of evolutionary history and ecology into planning area-based conservation. Simply the prioritisation of biodiversity hotspots including Sri Lanka to receive much of the global conservation funding is a decision informed by analyses in Conservation Biogeography. Landscape Ecology is akin to Conservation Biogeography, that is grounded in the reality of today's anthropogenically transformed world in which none of the ecosystems are found in large contiguous tracks, rather crisscrossed as interspaced habitat mosaics. Unlike traditional species-based to ecosystem-based conservation, the focus today is moving into those larger landscape mosaics where biodiversity disperses beyond the ecosystem boundaries. For example, elephant conservation or in other words mitigating human-elephant conflict can no longer be managed at species- or ecosystem-based approaches, it could only be understood and tackled through a landscape conservation design. The talk will introduce landscape-based approach of conservation planning giving you some real-time examples from Sri Lanka: such as Malwathuoya basin, central massif of the highlands landscape, and remarkable coral associated seascapes in Puttalam-Kalpititya, Silavaturai-Arippu-Vankalai in Gulf of Mannar, Vidattaltivu-Erumaitivu-Kakkativ and Iranativu of Palk Bay, Kuchchaveli-Nilaveli-Uppaveli in Trincomalee and Sallittivu-Kayankerni-Pasikuda in Batticaloa. I will touch upon the challenges faced and successes reached, giving hope for the future of landscape level conservation planning and applications on the ground. Besides my topic of the plenary, the rich and thoughtful programme lineup of the ICAPS2026, promises a clear future where science-based applications and decision making transforms our motherland and the world at large to a better place. I wish the ICAPS 2026, and all presenters today a great success!

Dr. Sandun J Perera
Programme Coordinator
Sri Lanka Country Office IUCN (International Union for Conservation of Nature)

Former Professor of Biogeography and Environmental Conservation
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A Preliminary Study on Heavy Mineral Distribution in the Walawe River Basin, Sri Lanka

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The Walawe Basin, the third-largest river basin in Sri Lanka, is underlain by Precambrian metamorphic terrain that hosts heavy minerals, key indicators of sediment provenance, transport, and depositional settings. However, detailed quantitative and spatial studies on heavy mineral distribution within the basin remain limited. This study investigates the distribution, concentration, and mineralogical composition of heavy minerals in stream sediments to assess their economic and gemstone potential. A total of 22 stream sediment samples were collected from the main river and its major tributaries. The 75 µm and 125 µm fractions were obtained by dry sieving, followed by magnetic separation and heavy-liquid separation using bromoform. Mineral identification and grain counting were conducted using a stereomicroscope and confirmed by FTIR spectroscopy, while statistical analysis (paired t-test, correlation, and linear regression) was performed using R. Grain size analysis revealed dominance of very coarse to coarse sand (>300 µm; mean 64.27%), indicating high-energy depositional conditions. A strong correlation ($R^2 = 0.856$, $p < 0.001$) between the magnetic percentage of the 75 µm and 125 µm fractions confirmed methodological consistency. Total Heavy Mineral (THM) concentrations ranged from 0.08% to 6.82% in the 75 µm fraction, and 0.16% to 9.02% in the 125 µm fraction, indicating enrichment in the 125 µm fraction (mean 2.71%). The highest THM concentrations were recorded in the Rakwana River (9.02%) and Katupath Oya (6.82%). Eleven heavy mineral species were identified in the basin sediments, including zircon, rutile, sillimanite, garnet, epidote, apatite, topaz, spinel, pyroxene, almandine garnet, and amorphous minerals. Sillimanite was the most abundant heavy mineral, and the presence of zircon, garnet, spinel, and almandine garnet confirmed the gemstone potential of the basin. This study provides a baseline for understanding sediment provenance, depositional processes, and the economic potential of heavy minerals in the basin, supporting sustainable resource management and future exploration.

Keywords: Gemstone potential, Heavy minerals, Sediment provenance, Stream sediments, Walawe Basin

Geospatial Modelling of Soil Organic Carbon Stocks and Erosion Risk in Low Country Tea Agro-Ecosystems of Sri Lanka

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Soil Organic Carbon (SOC) stocks in tropical agroecosystems are severely degraded by water-induced erosion, particularly in steeply sloped tea plantations. This study evaluated the impact of land use and soil erosion on SOC stocks across Medium-scale (>10acres), Small-scale (<10acres) tea plantations, and adjacent forest cover in the low country of Sri Lanka. Dual-methodological framework was utilized by integrating field-based soil sampling for estimating the SOC stocks using the Walkley and Black method with advanced spatial analysis using the InVEST Sediment Delivery Ratio (SDR) and Carbon Storage and Sequestration Models, and ArcGISPro 3.4.2. According to findings, SOC stocks significantly decreased as management intensity increased; consequently, the medium-scale exhibited severe carbon stock depletion, of a mean value of 71.19±15.37 Mg/ha, while forest cover maintained the highest mean SOC value of 100.23±16.04 Mg/ha, followed by small-scale, which also maintained a high mean value of 96.20±2.12 Mg/ha. A significant negative correlation was found between modelled erosion and SOC values in bivariate analysis (r = -0.61). Even after adjusting for bulk density, pH, EC, and elevation, the analysis statistically revealed the soil erosion as the primary and independent cause of SOC loss (Standardized β = -0.71, p<0.05). High-erosion landscapes contained considerably less SOC than low-erosion areas (W=50, p=0.008). The InVEST SDR outputs showed the highest erosion mean value of 23.61±13.38 tons/ha/yr in the medium-scale, a low value of 9.06±3.03 tons/ha/yr of sediment in the small-scale, and a very low amount of 0.13±0.13 tons/ha/yr in the forest cover. The SOC (<70Mg/ha) perfectly intersected with very high erosion hazard zones identified by the InVEST outputs, which were primarily within the intensively managed medium-scale tea plantation blocks. Since quantitative evidence proves topsoil sediment export primarily drives carbon depletion, prioritizing targeted erosion control in intensively managed medium-scale plantation is necessary to halt severe SOC loss and restore carbon sequestration.

Keywords: Carbon storage, Galle district, Hazardous zones, Hotspot analysis, InVEST Model

Depth-Wise Heavy Mineral Variation in Mining Pits As an Indicator of Gem Potential in Ratnapura, Sri Lanka

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This study focused on depth-wise heavy mineral variation in gem mining pits in Ratnapura, Sri Lanka. The lack of knowledge about the interpretation of gem potential and the concept of sustainable mining often leads to environmental damage. The primary objective of the study was to analyze depth-wise heavy mineral concentration and species variation with depth as indicators of gem potential. Sampling was conducted in three active mining pits at 5-ft depth intervals, following U.S. EPA soil sampling methods. The collected samples were processed for air-drying, oven-drying, wet-sieving, magnetic separation, and gravimetric separation using bromoform. The separated heavy minerals, including garnet, sapphire (a corundum variety), spinel, and sillimanite, were quantified via grain counting under a stereomicroscope based on the morphological characteristics, and their identity was confirmed by Fourier Transform Infrared Spectroscopy (FTIR). Twenty samples were collected from different depth levels and three geologically different locations. *Illama* can be represented as a sedimentary unit with high gem potential. The variation in total heavy mineral percentage with depth obtained from Location 1 (R^2 = 0.01, p = 0.809), Location 2 (R^2 = 0.28, p = 0.384), and Location 3 (R^2 = 0.25, p = 0.253) indicates that other geological or depositional factors may also have influenced the variation of heavy minerals in mining pits. However, sapphire and other specific heavy mineral species (R^2 > 0.5) showed possible depth enrichment in all three locations. These interpretations provide a useful guide for future gem potential predictions and lead to reducing unnecessary excavation, illegal mining activities, and environmental pollution while promoting sustainable mining.

Keywords: Heavy mineral distribution, Stratigraphic variation, Illama sediment, Sustainable gem mining

In Silico Analysis of the Biosynthetic Gene Cluster Involved in Squamatic Acid Production in *Cladonia squamosa*

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Lichens-forming fungi produce various secondary metabolites with remarkable biological activities. *Cladonia squamosa* produces squamatic acid, which is a β-orcinol depside with antibacterial, antioxidant, and anti-inflammatory properties. This study was conducted to identify the specific biosynthetic gene cluster (BGC) responsible for producing this compound, which has not been fully characterized at the genetic level. The *C. squamosa* genome was retrieved from the NCBI database, and its genes and biosynthetic gene clusters were annotated using GenSAS and antiSMASH. The polyketide synthase (PKS) gene for squamatic acid biosynthesis was identified using BLAST against known depside-producing PKS enzymes. Domain architecture for all PKS enzymes in C. squamosa was obtained from NCBI CD Search, while conserved motifs were identified using the MEME suite and visualized with TBtools. The phylogenetic analysis of all *C. squamosa* PKS enzymes and known PKS enzymes from depside-producing Cladonia and non-Cladonia lichen species, using the MUSCLE alignment and the maximum likelihood and neighbour-joining methods in MEGA software. AlphaFold3 predicted the three-dimensional structure of the PKS enzyme for squamatic acid production. The promoters of the squamatic acid BGC were analyzed using TBtools and the Promoter 2.0 tool, and physicochemical characteristics were also studied using the Expasy ProtParam tool. Results identified the PKS gene in region 4.2 (chromosome 4) as the best candidate, showing the highest similarity to the known PKS genes that catalyze the production of squamatic acid precursor molecules. The squamatic acid BGC includes the core biosynthetic gene encoding the PKS enzyme, transporter, and transcription factor, and additional genes; however, it lacks the tailoring enzymes. This research helps to fill a significant knowledge gap between chemical diversity and genetics.

Keywords: Biosynthetic Gene Cluster, In Silico Analysis, Polyketide Synthase, Squamatic

Assessment of the Impact of Internode Borer, *Chilo sacchariphagus indicus* (Lepidoptera: Crambidae) on Growth Parameters and Juice Quality of Sugarcane in Sri Lanka

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Internode Borer (INB) (*Chilo sacchariphagus indicus*) is an important pest of sugarcane in Sri Lanka. Determining the effects of this borer on plant growth, millable stalk weight, and juice quality is essential to implement timely preventive and control measures. Therefore, this study evaluated the effects of INB damage on plant growth, fresh weight, and juice quality parameters. Plant height, stalk diameter, number of internodes, number of leaves, leaf length and leaf width of a total of 200 plants of the variety SL 96 128 were recorded during a 4-month period from the 8th to 12th month's age. The weights were recorded separately for infested (n = 100) and uninfested stalks of SL 96 128 (n = 100) from the same clump at harvesting. Also, nodal weights were measured using infested and uninfested nodes of SL 96 128. Three sugarcane varieties from Sevanagala (SL 96 128, Co 775 and SL 00 652), and one variety each from Udawalawe and Ethimale (SL 96 128), were used to determine the Brix, Pol, Purity, POCS, and pH and fiber of INB-infested and uninfested stalks at harvest. Infested plants were categorized into three groups based on damage intensity: (1) 1.0–12.3%, (2) 12.4–23.7%, and (3) 23.8–35.1%. From each group, 12 millable stalks were collected, along with 12 healthy stalks for comparison. Juice analysis (Brix, Pol, Purity, POCS, and pH) and fiber were done using International Commission for Uniform Methods of Sugar Analysis (ICUMSA) methods. Results indicated that INB infestation significantly reduced plant height, stalk diameter, number of internodes, number of leaves, and leaf width, while leaf length remained unaffected. Despite these reductions in vegetative growth, no statistically significant differences were observed in the fresh weight of millable stalks or nodal weight. Juice quality assessments indicated that sucrose-related parameters, particularly Brix, Pol, and POCS, were most sensitive to infestation. These parameters consistently declined with increasing infestation levels across all three varieties, though the degree of reduction differed. SL 00 652 showed the greatest decline in multiple juice parameters, Co 775 exhibited a minimal response, while SL 96 128 displayed an intermediate effect. Fibre and pH remained largely unaffected, and Purity was generally stable across infestation levels, suggesting that INB damage affects the juice quality of sugarcane. Overall, INB infestation negatively affected vegetative growth and significantly reduced key sucrose-related juice quality parameters in sugarcane.

Keywords: Brix, Co 775, Juice quality, Plant height, SL 96 128

Soil Fertility Mapping and Spatial Variability Analysis for Site-Specific Nutrient Management in Rice Research Station, Ambalantota, Sri Lanka

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Soil fertility is inherently variable, and understanding its spatial distribution is vital to improve nutrient management and agricultural productivity. This study was conducted to evaluate the spatial variability of key soil chemical properties and develop fertility maps for site-specific nutrient management at the Rice Research Station, Ambalantota, Sri Lanka. A systematic sampling approach was used to collect 55 geo-referenced composite soil samples (0-20cm depth) from experimental plots prior to land preparation for the 2025/2026 Maha season. Collected soil samples were analyzed for soil pH and electrical conductivity (EC) by 1:5 soil-water suspension, available phosphorus (P) by Olsen's method, exchangeable potassium (K) by ammonium acetate extraction, and organic matter (OM) by Walkley-Black method. Spatial distribution maps were generated using Inverse Distance Weighting (IDW) Interpolation and soil fertility status was evaluated against Department of Agriculture (DOA) standards for Dry Zone paddy soils. The findings indicated substantial heterogeneity, with coefficient variation values of 3.72% for pH, 71.41% for EC, 66.84% for available P, 18.81% for exchangeable K, and 51.74% for OM. According to the DOA fertility standard, 70.9% of plots exhibited optimal pH (5.5-7.5), while 29.1% were alkaline (>7.5). Salinity stress was evident in 18.2% of plots exceeding 0.8 dS/m, predominantly in central- western low-lying areas. Available phosphorus exhibited a pronounced east-west gradient, with accumulation (>25 mg/kg) in 58.2% of plots and deficiency (<10 mg/kg) in 12.7%. Exchangeable potassium was sufficient across all plots, while organic matter ranged from critically low (0.64%) to adequate (6.26%). A strong positive correlation between EC and exchangeable K ($r=0.839$, $p<0.01$) identified potassium fertilization as major salinity contributors. This study provides the first high-resolution baseline fertility maps for the station, enabling transition from blanket recommendations to precision nutrient management, thereby improving experimental accuracy and resource efficiency.

Keywords: Precision Nutrient Management, Soil Fertility Mapping, Spatial Variability

Assessment of Nutrient Delivery Dynamics and Nonpoint Source Pollution Hotspot Delineation in the Upper Kotmale Watershed, Sri Lanka

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Nutrient exports from non-point sources pose a significant environmental threat to water quality in tropical highland regions undergoing intensive agricultural practices, and urbanization accelerates nitrogen (N) and phosphorus (P) export into the downstream. The Upper Kotmale Watershed is a vital part of Sri Lanka's upper montane zone, characterized by steep terrain, high annual rainfall, and dominant tea cultivation, making it more susceptible to non-point source nutrient contamination. InVEST Nutrient Delivery Ratio (NDR) model was employed to simulate nonpoint source pollution inflow and spatially quantify N and P export pathways and loads across the watershed between the years of 2000 and 2024. The model incorporated key spatial datasets of Digital Elevation Model (DEM), Land Use Land Cover (LULC), rainfall and nutrient load parameters. During the studied period, the mean annual total nitrogen export was 4.03 kg ha^{-1} $year^{-1}$ (ranging 0 – 19.69 kg ha^{-1} $year^{-1}$), and the mean annual total phosphorus export was 0.35 kg ha^{-1} $year^{-1}$ (ranging 0 – 9.04 kg ha^{-1} $year^{-1}$). Tea plantation is the dominant nutrient exporter in the watershed, contributing 81.8% of the total watershed total N export (101.23 t $year^{-1}$) and 68.4% of the total P export (7.37 t $year^{-1}$). Sub-watersheds dominated by forest cover showed noticeably reduced nutrient exports, underlining the nutrient-sink role of intact forest cover, while sub-watersheds in lower altitudes received more rainfall showed significantly higher exports. A conservation priority area was identified by using hot and cold spot analysis of the Getis-Ord Gi* statistic. The hotspot maps reveal that at the 99% confidence level, 28.2% of the P export and 26.5% N export areas are spatially distributed hotspots. The findings provide targeted watershed management initiatives with a spatially explicit framework for reducing non-point source nutrient pollution, protecting downstream water quality, and maintaining the biological integrity of the region.

Keywords: GIS-Based Modelling, Hotspots, InVEST NDR model, Non-point source pollution, Upper Kotmale Watershed

Modelling Soil Erosion and Sediment Export in the Belihuloya GND: An Application of the InVEST–SDR Model

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Human-induced soil erosion (SE) is one of the pressing environmental challenges in tropical regions and remains a critical land degradation concern in Sri Lanka, where it significantly threatens agricultural productivity and water quality. This study focuses on the Belihuloya Grama Niladhari Division (GND) (approx. 4 km^2 and a population of about 789) and where steep terrain, high annual rainfall, and increasing agricultural and human interventions create conditions favorable to accelerated erosion, yet no site-specific quantitative assessment has previously been conducted to establish baseline soil loss and sediment export rates. Without such fine-scale data, targeted conservation and land management interventions cannot be effectively prioritized. The study aimed to evaluate mean annual soil loss, SE potential, sediment export and sediment retention across Belihuloya GND. To achieve this, a coupled Revised Universal Soil Loss Equation (RUSLE) approach was employed, integrating the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Sediment Delivery Ratio (SDR) model with Geographic Information System (GIS) tools. Key model inputs included a Digital Elevation Model (DEM), 2024 average rainfall data, rainfall erosivity (R), soil erodibility (K), land use and land cover classifications: Grassland (29.89%), Homesteads/Gardens (15.52%), Forest Plantation (15.20%), Open Forest (2.29%), Paddy (8.71%), Tea (3.60%), and Barren Land (2.35%) along with relevant biophysical data. The results revealed a mean SE potential of 2.693 t/ha/yr, while mean annual soil loss ranged from $7.4e^{-07}$to 2.822 t/ha/yr, with an average value of 0.164 t/ha/yr. Mean sediment export, avoided erosion and avoided export were estimated at 0.0086, 2.529 and 0.175 t/ha/yr, respectively. Notably, mean annual soil loss remained well below the permissible threshold of 5 t/ha/yr. This can largely be attributed to the area's substantial forest cover and low soil-disturbing land uses, viz. smallholder well-managed tea and paddy cultivation, which collectively reduce erosion, enhance natural sediment retention and minimize downstream impacts..

Keywords: Belihuloya GND, InVEST-SDR model, Soil Erosion

Hospital Waste Water as a Reservoir of Antibiotic-Resistant Bacteria: A Study from a Tertiary Care Hospital in Sri Lanka

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Antibiotic resistance is a growing global public health concern, particularly due to the release of resistant microorganisms into the environment through hospital wastewater. This study aimed to isolate and identify antibiotic-resistant bacteria from wastewater samples collected from the Teaching Hospital, Ratnapura, a tertiary healthcare facility in Sri Lanka. As a preliminary investigation, bacterial isolates resistant to three commonly used antibiotics, namely ampicillin, gentamicin, and streptomycin, were screened and characterized. Wastewater samples were collected, serially diluted and cultured on antibiotic-supplemented agar media by the spread plate method. Resistant bacterial colonies were selected, purified using the quadrant streaking method, and further characterized based on colony morphology, Gram staining, and biochemical tests, including catalase, citrate utilization, motility, methyl red, and Voges–Proskauer tests. The total antibiotic-resistant bacterial counts recorded on blood agar, nutrient agar, McConkey agar, and Eosin Methylene Blue agar were 1.0×10^6 CFU/mL, 1.7×10^6 CFU/mL, 1.5×10^4 CFU/mL, and 2.0×10^4 CFU/mL, respectively. Based on selective and differential media observations, the count of Gram-negative lactose-fermenting resistant bacteria was estimated as 2.0×10^4 CFU/mL. A total of 11 morphologically distinct bacterial isolates were obtained from different dilution levels. The identified resistant bacterial types included *Klebsiella pneumoniae, Citrobacter freundii, Acinetobacter baumannii, Staphylococcus aureus, and Enterococcus* spp. The findings indicate the presence of multiple antibiotic: ampicillin, gentamicin, and streptomycin resistant, bacterial species in hospital wastewater, including clinically significant organisms. Overall, this preliminary study highlights hospital wastewater as a potential reservoir for antibiotic-resistant bacteria. The presence of such organisms in wastewater may contribute to the environmental spread of resistance genes through horizontal gene transfer. Therefore, continuous monitoring of hospital wastewater, proper treatment prior to discharge, and improved wastewater management practices are essential to reduce the risk of antibiotic resistance dissemination into the surrounding environment.

Keywords: Antibiotic resistance, hospital wastewater, multidrug-resistant bacteria, bacterial isolation; antibiotic susceptibility testing

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Transforming Food Systems for Safe, Sustainable and Healthy Diets in Sri Lanka

Food systems are fundamental to nutrition, health and environmental sustainability, yet they are increasingly challenged by climate change, biodiversity loss, resource constraints, food insecurity and changing dietary patterns. The coexistence of undernutrition, micronutrient deficiencies, overweight, obesity and diet-related non-communicable diseases (NCDs) highlights the need to transform food systems from a focus on food availability towards systems that consistently deliver safe, affordable, nutritious and sustainable diets. A nutrition-centred food-system transformation is therefore essential to improve dietary quality and address multiple forms of malnutrition.

Transforming food systems requires an integrated approach spanning food production, processing, distribution, retail, food environments and consumption. From a nutrition perspective, this includes promoting diversified and nutrition-sensitive agriculture; improving the availability, affordability and accessibility of nutrient-dense foods; protecting nutrient quality during processing and storage; strengthening food safety; and creating food environments that facilitate healthier choices. Greater consumption of vegetables, fruits, whole grains, legumes, nuts and other nutrient-rich foods, together with appropriate consumption of animal-source foods and reduced intake of energy-dense, nutrient-poor and highly processed foods, can contribute to improved nutrient adequacy and reduced risk of diet-related NCDs. Sustainable dietary shifts may simultaneously reduce environmental pressures.

However, sustainable diets cannot be promoted through dietary recommendations alone. Affordability, cultural acceptability, food availability, consumer preferences and the broader food environment strongly influence dietary choices. Recent global evidence demonstrates that food-price inflation continues to undermine the affordability of healthy diets, particularly among economically vulnerable populations. Consequently, food-system transformation must place equity at its centre, ensuring that healthier and sustainable diets are accessible across different socioeconomic and cultural contexts.

This presentation highlights opportunities to connect nutrition science with food innovation, nutrition-sensitive agriculture, healthier food reformulation, sustainable processing, food safety, improved food environments, food loss reduction and evidence-informed nutrition policies. A nutrition-centred food-system approach can translate food-system innovation into meaningful improvements in dietary quality, nutritional status, health and wellbeing, while strengthening resilience and sustainability.

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Development and Quality Evaluation of Tisane from Seeni kesel peel (*Musa spp*) and Sweet orange peel (*Citrus sinensis*)

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Interest in functional beverages has led to research on fruit by-products like Seeni kesel (*Musa spp.*) and sweet orange (*Citrus sinensis*) peels, which contain bioactive compounds and have potential for nutritional herbal tisanes. This study aimed to develop and evaluate a tisane, a hot-water infusion of plant materials other than *Camellia sinensis*, using Seeni kesel (*Musa spp.*) and sweet orange (*Citrus sinensis*) peels. Orange peels were dried at 55 °C for 8 hours, and banana peels were dried at 55 °C for 10 hours. The dried samples were ground into fine powders and blended to formulate the tisane powder. Five formulations were developed (100% banana peel, 75% banana peel and 25% orange peel, 50% banana peel and 50% orange peel, 25% banana peel and 75% orange peel, and 100% orange peel). Mixtures (2 g) were bagged and steeped in 80 °C hot water for 5 minutes. The study assessed pH, cytotoxicity using the Brine Shrimp Lethality Assay, and sensory evaluation using a 5-point hedonic scale with 30 semi-trained panelists to identify the most acceptable formulation. The total phenolic content and antidiabetic potential of the selected formulation were evaluated using the glucose uptake by yeast cell method. Significant differences ($p < 0.05$) in pH values were found among formulations. Banana and orange peel formulations showed high LC_{50} values, indicating low toxicity compared to potassium dichromate. The highest overall acceptability score (4.03 ± 0.89) was obtained for the formulation containing 75% orange peel and 25% banana peel, which was selected as the optimum formulation. The phenolic content of the selected formulation was 2.29 ± 0.01 mg GAE/g. *In vitro* antidiabetic activity, assessed by the yeast cell glucose uptake assay, showed 44.7% glucose uptake at 500 ppm, suggesting that the formulation containing 75% orange peel and 25% banana peel has potential for development as a functional beverage utilizing agro-waste.

Keywords: Antidiabetic Activity, Seeni Kesel (*Musa spp.*) Peel, Sweet Orange (*Citrus Sinensis*) Peel, Tisane Formulation

Development and Characterization of a Novel Plant-Based Liquid-Filled Chewing Candy Using Xanthan and Guar Gum with Betel (*Piper betle* L.) Leaf and Mint (*Mentha spp.*) Extracts

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Plant-based confectionery systems utilizing natural hydrocolloids are emerging as promising alternatives to conventional chewing candies based on synthetic or animal-derived gum bases. This study aimed to develop a novel chewing candy using xanthan gum and guar gum to replace conventional gum bases while providing desirable texture, incorporating aqueous extracts of betel (*Piper betle* L.) and mint (*Mentha spp.*) for flavoring. Three xanthan-to-guar gum ratios (1:1, 1:2, 1:3) were formulated as texturing agents. The gum base was complemented with glucose syrup, powdered sugar, food-grade glycerin, and citric acid. Betel leaf extracts were prepared by double-boil hot water extraction at 50–60°C across 1, 1.5, and 2-hour durations; 100 ppm at 1 hour was identified as safe via brine shrimp lethality assay, and incorporated with mint extract as the syrup filling. The developed candies were evaluated for sensory attributes, texture profile, moisture content, water activity, pH, and sugar content. Statistical analyses were performed at a 95% confidence level using Minitab 22. Texture profile analysis showed a hardness 271.90 ± 14.00 g, significantly lower than the commercial product (1140.01 ± 3.10), with adhesiveness of 0.20 ± 0.01 mJ, cohesiveness of 0.21 ± 0.01, gumminess 57.03 ± 2.45 g, springiness 1.99 mm, and chewiness 1.22 ± 0.20 mJ. The candy demonstrated a water activity of 0.69 ± 0.02 and moisture content of 5.90 ± 0.14%. Initial pH of the candy (4.67 ± 0.25) was stable over the study period with LDPE packaging with contributes to microbial stability and desirable flavor. The candy with 1:2 gum base and 1:2 betel-mint ratio was selected as the best formulation based on the highest overall sensory acceptability. Hence, the xanthan-guar gum based system effectively replaced conventional gum bases in chewing candy applications while enabling incorporation of plant extracts.

Keywords: Betel Leaf Extract, Chewing Candy, Guar Gum, Plant-based Confectionery, Xanthan Gum

Investigating the Effects of Essential Oil Infused Hydrogel Beads for Extending the Shelf-Life of Sour Banana (*Musa* spp.)

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The post-harvest loss of banana is a major challenge in developing countries due to limited cold chain facilities. This study developed hydrogel beads using locally available agro-waste jackfruit seed flour (JSF), incorporated with cinnamon and lemongrass essential oils (EO) to extend the shelf life of sour banana (*Musa* spp.) without direct fruit application. Sodium alginate (SA) was used as the bead-forming polymer while crosslinked with calcium chloride. Eight treatments were evaluated: untreated control, Carbendazim commercial treatment, SA, SA+JSF, SA+JSF+Xanthan gum (XG), and SA+JSF+XG containing EO blends at 0.5%, 1.0%, and 1.5%. Twelve bananas per treatment were stored at 25 ± 2°C, and weight loss %, decay index, titratable acidity (TA), total soluble solids (TSS), and the ascorbic acid content (AAC) were measured on days 0, 7, and 14. Data in triplicates were analyzed by two-way ANOVA, followed by Tukey's HSD test ($p < 0.05$). After 14 days, the 0.5% EO treatment showed the lowest weight loss (10.20%), significantly lower than the untreated control (59%) and comparable to Carbendazim (12.48%). Moreover, the 0.5% EO treatment exhibited the significantly lowest decay index (60%) at day 14, followed by the control (77%) and commercial treatment (95%). For TSS, the 0.5% EO treatment maintained stable values (17.33°Brix at day 14), indicating slower ripening. Ascorbic acid content was the highest at day 7 for the 0.5% and 1% EO treatments (30.93–31.00 mg/100 mL), though it declined by day 14. Overall, the hydrogel beads containing 0.5% EO effectively reduced weight loss and delayed decay compared to the control and performed comparably to the commercial fungicide, while higher essential oil concentrations were less effective. The use of EO infused JSF hydrogel beads offers a sustainable and eco-friendly alternative for post-harvest preservation of sour bananas in developing countries.

Keywords: Essential Oil, Hydrogel Beads, Jackfruit Seed Flour, Post-Harvest Preservation, Sour Banana

Evaluating the Ethical Marketing Issues on the Purchasing Behaviour of Consumers: With Special Reference to the Product of Coconut Oil

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This study investigates the impact of ethical marketing issues on consumer purchasing behaviour in Sri Lanka's coconut oil market, specifically within the Kurunegala District—the country's largest coconut-producing region. A quantitative design with a deductive approach was adopted, drawing a sample of 390 consumers from a target population of approximately 1.6 million individuals across rural, semi-urban and urban areas, with stratified random sampling ensuring representativeness across gender, age, education and income. Data were collected via face-to-face structured questionnaires and analyzed using SPSS version 27, employing multiple linear regression. Prior assumption testing confirmed normality, linearity, homoscedasticity and absence of multicollinearity. Pearson correlations revealed significant bivariate relationships for all four variables: misleading advertising ($r = 0.154$, $p = 0.002$), deceptive packaging ($r = 0.321$, $p < 0.001$), environmental care ($r = 0.242$, $p < 0.001$) and customer care ($r = 0.267$, $p < 0.001$). However, the overall regression model was statistically significant ($F(4, 385) = 18.554$, $p < 0.001$) but explained only 16.2% of the variance ($R^2 = 0.162$). Deceptive packaging was the sole significant independent predictor ($\beta = 0.238$, $p = 0.009$), remaining robust after Bonferroni correction, while the other three variables showed no independent effects. Although 81% of respondents expressed preference for socially responsible brands, the low explanatory power suggests ethical perceptions are not primary drivers. The cross-sectional, self-reported, single-district design limits causal inference. These findings tentatively highlight packaging integrity; however, future research should incorporate price sensitivity, habitual buying, and cultural factors. Based on these results, manufacturers should prioritize transparent packaging, accurate labelling and origin certification, while regulators must enforce stricter standards to build consumer trust and protect market integrity.

Keywords: Coconut Oil Industry, Consumer Purchasing Behaviour, Corporate Social Responsibility, Deceptive Packaging, Ethical Marketing

Factors Influencing Consumers' Willingness to Consume Functional Flour: With Special Reference to the Urban Population of Sri Lanka

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This study examined the behavioural, social, and psychological determinants of willingness to consume functional flour among 391 urban consumers in Kurunegala District, Sri Lanka. Grounded in the Theory of Planned Behaviour and Social Cognitive Theory, the quantitative cross-sectional survey tested six predictors: Utilitarian Eating Values, Hedonic Eating Values, Injunctive Norms, Descriptive Norms, Perceived Behavioural Control, and Self-Efficacy. The regression model was significant, $F(6, 384) = 35.00$, $p < .001$, explaining 30.5% of the variance in the dependent variable ($R^2 = .305$; Adjusted $R^2 = .294$). It revealed three significant predictors. Self-Efficacy was the strongest driver ($\beta = 0.403$, $p < 0.001$), followed by Injunctive Norms ($\beta = 0.176$, $p < 0.001$) and Descriptive Norms ($\beta = 0.164$, $p = 0.001$). Utilitarian and Hedonic Eating Values and Perceived Behavioural Control were not significant. Over 74% of respondents already intended to consume functional flour regularly. The measurement scales demonstrated satisfactory reliability and validity based on internal consistency and correlation analysis. Willingness was more strongly associated with personal confidence and social environment factors than with health or taste-related considerations. Self-Efficacy is the dominant lever: consumers who believe they can successfully change their eating habits are most likely to adopt functional flour. Social norms powerfully reinforce this belief – both approval from family and peers (injunctive norms) and observing others making healthier choices (descriptive norms) significantly amplify adoption. Consumers demonstrate psychological readiness; the central challenge is converting intention into sustained behaviour. Manufacturers should use cooking demonstrations and testimonials to build self-efficacy. Policymakers should ensure equitable access and transparent labelling. Limitations include geographic restriction to the Kurunegala urban area, cross-sectional design, self-report bias, and unexamined supply-side variables.

Keywords: Functional Flour, Self-Efficacy, Social Norms, Sri Lanka, Willingness to Consume

Incorporation of Jackfruit Seed Flour (*Artocarpus heterophyllus* Lam.) as a Functional Ingredient by Replacing Modified Tapioca Flour in Formal Chicken Sausages

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This study evaluated the feasibility of utilizing jackfruit (*Artocarpus heterophyllus* Lam.) seed flour (JFSF) as a functional substitute for modified tapioca starch in emulsified chicken sausage formulations and assessed the functional, nutritional, physicochemical, and organoleptic properties of both the flour and the sausages. The yield of JFSF was 37.5 ± 0.85%; the carbohydrate, crude-fiber, crude-protein, and crude-fat were 61.72 ± 0.34%, 12.2 ± 0.18%, 11.5 ± 0.21%, and 2.5 ± 0.30%, respectively. During 28 days of ambient storage, JFSF maintained excellent stability, showing a slight decrease of pH from 6.4 to 5.8, and a minor increase in moisture content (9.81% to 10.09%), while water activity remained stable. JFSF also demonstrated favorable techno-functional properties, including high water-holding capacity (3.17 ± 0.04 g/g) and swelling capacity (3.12 ± 0.11 mL/g). Qualitative phytochemical screening confirmed the presence of bioactive compounds of flavonoids, tannins, and alkaloids. Among the formulations evaluated, incorporation of 3% JFSF provided the optimal balance of functional, nutritional, and structural characteristics of chicken sausage; exhibited superior antioxidant activity (DPPH IC_{50} = 518.41 μg/mL compared with 680.79 μg/mL in the control) and improved emulsion stability. It also showed acceptable cooking loss (5.84–6.09%), lower extracted water content (6.49–9.15%), greater hardness, and lower adhesiveness than the control. FTIR spectroscopy confirmed stronger hydrogen bonding, more prominent amide I and II bands, and enhanced polysaccharide interactions. Eventually, the pH remained at 6.19 ± 0.03, lightness decreased, redness and yellowness were not significantly changed, and the product remained stable during three months of frozen storage and complied with Sri Lanka Standards (SLS) requirements. In conclusion, JFSF is an effective, nutritious, and sustainable alternative to modified tapioca starch in emulsified chicken sausage production. Its incorporation significantly enhances the antioxidant, functional, and nutritional properties of the final product while providing a sustainable approach to the valorization of jackfruit seed as an agricultural by-product.

Keywords: Chicken Sausage, Jackfruit Seed, Jackfruit Seed Flour (JFSF), Modified Tapioca Starch

Development of Functional Herbal Cheese Fortified with *Asparagus racemosus* L. (Hathawariya): Evaluation of Bioactive, Physicochemical, and Sensory Parameters

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Cheese remains a globally ubiquitous dairy staple; therefore, there is a burgeoning scientific interest in enhancing its nutritional and therapeutic profile through the incorporation of botanical additives. The present study developed a functional herbal cheese by fortifying it with leaf powder from *Asparagus racemosus* L. (Hathawariya), a plant highly regarded for its dense nutrient profile, potent antioxidant capacity, and diverse bioactive properties. The primary objectives of this research were to determine the optimal mixing ratio of *A. racemosus* to cheese, evaluate its impact on organoleptic attributes, and assess the physicochemical stability and microbial shelf-life of the final product. The experimental framework utilized air-dried *A. racemosus* leaf powder at varying concentrations: 0.1% (T1), 0.2% (T2), 0.3% (T3), and 0.4% (T4) (w/v), alongside a 0% control (T0). Each treatment was replicated three times to ensure statistical accuracy. Sensory evaluation, conducted by 30 semi-trained panelists on a nine-point hedonic scale, revealed a significant difference between samples ($p < 0.05$). The 0.1% (T1) formulation was identified as the significantly ($p < 0.05$) most organoleptically acceptable and was subsequently selected for comprehensive quality parameter analysis. Accordingly, physicochemical analysis demonstrated that the inclusion of 0.1% *A. racemosus* did not significantly ($p > 0.05$) adversely affect the protein or fat content. However, it successfully introduced dietary fiber (0.025%)—which was absent in the control—and significantly increased the ash content to 4.6%, compared to 2.63% in the T0 sample ($p < 0.05$). Furthermore, the T1 sample exhibited superior structural stability, with significantly ($p < 0.05$) lower syneresis (12.02%) and moisture content (45.81%) than the control (14.31% and 46.32%, respectively). The bioactive profile of the herbal cheese was markedly enhanced; T1 exhibited an antioxidant capacity of 0.8 μM Trolox/g, flavonoid content of 495 μg QE/g, and phenol content of 1050 μg GAE/g, representing a substantial increase over the control values (0.25 μM Trolox/g, 86 μg QE/g, and 260 μg GAE/g, respectively). During an 8-week storage period at 4°C, the herbal cheese maintained a lower pH (5.0 ± 1.0) and higher titratable acidity (TA) (0.38 ± 0.07%) than the control (pH 5.5 ± 0.8, TA 0.35 ± 0.05%). Moreover, the T1 formulation demonstrated improved antimicrobial properties, with lower Aerobic Plate Counts (5 CFU/g) and yeast/mold counts (4 CFU/g) throughout the storage duration of 8 weeks at 4°C. The present study concludes that 0.1% (w/v) *A. racemosus* leaf powder is an optimal formulation for creating a functional herbal cheese with superior antioxidant properties and improved shelf-stability.

Keywords: Antioxidants, Bioactive Properties, Herbal Cheese, Organoleptic Properties, Shelf-Stability

Development and Quality Characterization of a Nutrient-Enriched Functional Sauce Incorporating Moringa (*Moringa oleifera*) Paste and Honey

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Moringa oleifera is recognized for its exceptional nutritional and functional properties, being rich in proteins, vitamins, minerals, dietary fiber, and natural antioxidants. Despite its health benefits, the incorporation of moringa into value-added sauce products remains limited. This study aimed to develop a functional sauce enriched with moringa paste and honey, and to evaluate its sensory, physicochemical, nutritional, and microbiological qualities. Three sauce formulations were prepared containing varying levels of moringa paste (20%, 22%, and 24%) in combination with honey, coconut vinegar, spices, and xanthan gum. Sensory evaluation was conducted using 15 untrained panelists based on a five-point hedonic scale. Among the formulations, F3 containing 24% moringa paste achieved the highest scores for appearance, colour, aroma, taste, texture, and overall acceptability, indicating superior consumer preference. The selected formulation exhibited appreciable nutritional quality, particularly in terms of protein and dietary fiber content. Physicochemical parameters including pH, total soluble solids (°Brix), titratable acidity, and viscosity remained within acceptable ranges throughout the storage period. Microbiological analysis demonstrated that the sauce was microbiologically safe for consumption for up to 14 days, with acceptable total plate counts and yeast and mold counts, while coliform bacteria were absent. The findings suggest that moringa paste and honey can be effectively utilized as functional ingredients in the development of a nutritious and naturally formulated sauce product. This study highlights the potential of moringa-based sauces as healthier alternatives to conventional sauces and provides a foundation for future research on shelf-life extension and commercial application.

Keywords: functional sauce, honey, moringa, nutrient-rich food, physicochemical properties, sensory evaluation

Development of Essential Oil Based Vapour Releasing Formulation to Control Stem End Rot and Anthracnose in Mango (*Mangifera indica* L.)

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Mango (*Mangifera indica* L.) is a premier export-oriented fruit in Sri Lanka. However, its marketability is constrained by postharvest diseases, particularly stem end rot (SER) and anthracnose. This study aimed to develop an essential oil (EO)-based vapor-phase product to control these diseases. The causative pathogens were isolated and identified morphologically. The inhibitory effects of three selected essential oils (thyme, cinnamon and clove), individually and in combination were evaluated against *Lasiodiplodia theobromae* (SER) and *Colletotrichum gloeosporioides* (anthracnose) by disc volatilization method in vitro. A beeswax-based prototype containing the minimum inhibitory concentration (MIC) of the combined essential oils was formulated for sustained vapor release. The in vivo efficacy of the formulation was evaluated by artificially inoculating mangoes and exposing them to vapor treatments at concentrations of 50, 100 and 200 μL/L (1–4 MICs) in the container headspace. To monitor quality changes, appearance, weight loss, total soluble solids (TSS), and firmness were assessed in treated and untreated samples stored at ambient conditions for 14 days. The essential oil combinations exhibited synergistic antifungal effects. Complete mycelial growth inhibition occurred at 4 μL/plate (2:1:1 ratio) for *L. theobromae* and 3 μL/plate (1:1:1 ratio) for *C. gloeosporioides*. The prototype containing combined EO concentration of 100 μL/L (as 2:1:1 of thyme, cinnamon and clove EOs) significantly reduced SER and anthracnose incidence and severity compared with the control. Treated mangoes showed reduced decay and delayed ripening, extending shelf life by more than 6 days at ambient conditions. The developed prototype demonstrates potential as a safe, natural alternative to conventional postharvest disease-control methods for extending mango storage life.

Keywords: *C. gloeosporioides*, essential oils, *L. theobromae*, mango, postharvest diseases

Development and Evaluation of a Corn Starch-Based Biodegradable Film Incorporated with Mixed Anthocyanins from Red Cabbage (*Brassica oleracea*) and Butterfly Pea Flower (*Clitoria ternatea*)

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Fish and meat are highly susceptible to spoilage. Conventional packaging uses fixed expiry dates that may not reflect actual freshness. In this study, an intelligent film was fabricated from commercially available corn starch and incorporated with mixed anthocyanins extracted in the laboratory from red cabbage and butterfly pea flowers (1:1 v/v). The film-forming solution prepared from corn starch, anthocyanin, and glycerol was added to molds and dried. The film functions as a pH-sensitive indicator for visual monitoring of meat and fish freshness, offering a sustainable method for real-time food quality assessment. The pH sensitivity of the mixed anthocyanin extract was confirmed using buffer solutions over a pH range of 1–13. The film exhibited moderate moisture content (14.29 ± 0.56%), low water activity (0.692 ± 0.009), and controlled water solubility (4.36 ± 1.55%). The film containing anthocyanin showed a hardness of 1591.7 ± 75.1 g, and the corn starch-only control showed a slightly higher hardness of 1606.5 ± 128.9 g, indicating that anthocyanin incorporation had minimal effect on film hardness. Meat and fish were stored in transparent containers at room temperature, with the freshness-indicating film attached to the headspace. Spoilage released alkaline volatile compounds, raising the headspace pH and causing a visible color change in the indicator. Colorimetric analysis showed a clear visual response during spoilage. Before storage with fish or meat samples, the film had an actual pink color with a positive Δa^* value (19.01 ± 3.07). During storage with meat and fish samples at room temperature, a visible color change to blue occurred within less than 12 hours. After four days, the film shifted to blue-green, and the Δa^* value became negative (−2.38 ± 1.39), confirming a red-to-green transition. The films completely biodegraded within 4 days in the soil burial test, demonstrating rapid degradation under natural soil conditions.

Keywords: Anthocyanin Extract, Biodegradability, pH Sensitivity, Smart Packaging, Sustainability

Single Laboratory Validation of a Sensitive LC-MS/MS Screening Method for Multi-Class Veterinary Drug Residues and Aflatoxin M1 in Bovine Milk

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A low volume solvent extraction method was validated for the simultaneous extraction and clean-up for the quantitative screening of 19 veterinary drug residues (8 sulfonamides, 3 penicillins, 2 cephalosporins, 2 macrolides, 2 fluoroquinolones, an amphenicol, and a diaminopyrimidine) and aflatoxin M1 (AFM1) in bovine milk in line with (EU) 2021/808 and ISO/IEC 17025:2017. The screening target concentration (STC) was set at 20% of the EU Maximum Residue Limit (MRL) for authorized substances, the reference point of action (RPA) for chloramphenicol, and the national regulatory limit of 0.5 μg/kg for AFM1. Blank milk samples (n = 18) were spiked at STC, and percentage recoveries were evaluated against matrix-fortified mix calibration standards (0.05–1.0 MRL). For the extraction and clean-up, fortified and blank milk samples were frozen at −25°C, freeze-dried before extraction with 2 mL of methanol:acetonitrile (2:3). This pre-concentration step helped improve the analyte recovery while minimizing solvent consumption. Liquid chromatography in gradient mode with 1% formic acid in acetonitrile and 1% formic acid in water as solvents and a reversed-phase (C18) HPLC column were used for the chromatographic separation. LC-MS/MS with electrospray ionization (+/− ESI) in multiple reaction monitoring (MRM) mode was used for the identification and quantification within a total run time of 13 min. Results yielded weighted linear regression (1/x) correlation coefficients (R^2) ranging from 0.9901 to 0.9992. Recoveries of 85%–120%, within-lab repeatability and intermediate precision values (%RSD) of 5%–18% and 10%–20% respectively, were also achieved across all 19 analytes and AFM1. Detection capability (CCβ) values ranged from 0.04 μg/kg to 26.5 μg/kg. Compared with conventional QuEChERS, SPE, and solvent-extraction approaches, the proposed method offers a more practical and greener alternative because it uses less solvent, avoids single-use extraction kits, and remains suitable for sensitive multi-residue screening in milk.

Keywords: Aflatoxin M1, Bovine Milk, LC-MS/MS, Low Volume Solvent Extraction, Veterinary Drugs

Development of a Food-Grade Sanitizer from Fresh Green Tea (*Camellia sinensis*) Leaves

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Foodborne illness remains a major public health concern worldwide, primarily resulting from microbial contamination of food contact surfaces. Although chemical sanitizers are widely used, concerns about toxic residues, environmental impacts, and microbial resistance have increased interest in natural and safer alternatives. However, only limited research has been conducted on the development of herbal sanitizers from tea leaves. Therefore, the present study was carried out to develop and evaluate a food-grade sanitizer from fresh green tea (*Camellia sinensis*) leaves. Fresh tea leaves collected from low-country elevation (Matugama region, Sri Lanka) were separated into mature and immature (bud and first two leaves) leaf categories. Extracts were prepared using three types of solvent mixtures: 99% ethanol, 50% ethanol, and 100% distilled water. Antimicrobial activity was evaluated against *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 35218), and *Salmonella spp*. (ATCC 14028) using the disc diffusion method. Ethanol (99%) extracts demonstrated significantly higher antimicrobial activity (ZOI: 17.9–21 mm for *Staphylococcus aureus*) compared to water extracts ($P < 0.001$). Leaf maturity had no significant impact on the antimicrobial activity of the extracts ($P > 0.05$), suggesting that mature leaves are a suitable raw material for the product. Four sanitizer formulations (F1–F4) with varying concentrations of tea extract (2–20%), ethanol (1–10%), and hydrogen peroxide (0.05–0.5%) were developed and tested on food contact surfaces. Among the four formulations, F2 (10% tea extract, 5% ethanol, 0.03% water) achieved the highest log reduction (99%) of *Staphylococcus aureus*, showed no visible staining, and maintained a stable pH over a 30-day storage period, making it the optimum formulation. The findings of this study suggest that tea leaf-based sanitizers have considerable potential as a sustainable alternative to conventional chemical sanitizers. In addition, the utilization of mature tea leaves supports sustainable waste utilization and value addition within the tea industry. The developed formulation represents a promising environmentally friendly and consumer-acceptable sanitizer.

Keywords: Antimicrobial Activity, *Camellia Sinensis*, Food Safety, Food-grade Sanitizer, Green Tea

Evaluation of the Solus ELISA for reliable detection of *Salmonella* spp. in coconut products using large test portions (250 g): a fractional study without reference method

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As contamination is typically low and heterogeneous, detection of *Salmonella* in low-moisture coconut products using conventional 25 g test portions is challenging. This study evaluated the Solus *Salmonella* ELISA as a rapid screening method for qualitative detection of *Salmonella* spp. in desiccated coconut and coconut powder using 250 g test portions, following the single-laboratory method without a reference method approach of ISO 16140-4:2020/Amd 1:2024. A fractional design was applied by spiking 250 g samples with *Salmonella enterica* (subsp. *salamae* serovar Tranoroa) at low, fractional (0.2–2 CFU/250 g) and high (2–10 CFU/250 g) levels. Uninoculated samples were used as negative controls and *Escherichia coli* was used as a non-target organism to assess possible cross reactivity. Samples were pre-enriched in Buffer Peptone Water, selectively enriched in Rappaport Vassiliadis Soya Broth, heat-treated, and analyzed using the Solus *Salmonella* ELISA. Presumptive positive samples were confirmed using ISO 6579-1 biochemical and serological tests. Probability of detection (POD), sensitivity, specificity, and accuracy were calculated under two experimental settings that differed in analyst, media lot, culture condition, and incubation time. All uninoculated controls were negative, giving a specificity 1.000, while all high-level inoculated samples were positive, giving a POD 1.000 in both matrices and settings. At the fractional level, partial detection was observed, with POD values ranging from 0.75 to 1.00, as expected near the detection limit. No significant differences were observed between settings or matrices for POD, sensitivity and accuracy ($p > 0.05$). No cross-reactivity with *E. coli* was observed. These findings indicate that Solus *Salmonella* ELISA provides a stable and specific rapid screening option for detecting *Salmonella* spp. in 250 g portions of desiccated coconut and coconut powder under single-laboratory conditions. Therefore, the method can support routine microbiological monitoring of export-oriented coconut products, although further validation using additional coconut matrices and *Salmonella* serovar is recommended.

Keywords: Coconut-based Products, Export Coconut, Large Test Portions (250 g), *Salmonella* Detection, Solus ELISA

Development and Evaluation of Functional and Physicochemical Properties of a Carbonated Ready-to-Drink Tea Prepared from Ceylon Black Tea and *Mimosa pudica*

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Lifestyle changes associated with the COVID-19 pandemic have been reported to contribute to the expansion of the functional beverage market. Ceylon black tea is recognized for its antioxidant properties, while *Mimosa pudica* (Fabaceae) is traditionally used in herbal preparations and contains bioactive compounds associated with antioxidant activities. This study aimed to develop a carbonated Ready-to-Drink tea incorporating *M. pudica* and evaluate its sensory acceptability, physicochemical properties, functional properties, and preliminary toxicity profile. Ten formulations (F1–F10) were prepared by varying Ceylon black tea and *M. pudica* roots, leaves, and stems (1.5–2.5 g each), while maintaining sugar (14 g), citric acid (0.8 g), and final volume (200 mL). The control formulation (F10) contained Ceylon black tea without *M. pudica*. All formulations were screened based on pH, Total Soluble Solids (TSS), and sensory characteristics.Based on screening results, F2, F4, F8, and F10 were selected for sensory evaluation using a 5-point hedonic scale considering appearance, aroma, taste, mouthfeel, aftertaste, and overall acceptability. F4 showed the highest sensory acceptability (5.0 ± 0.0) and was selected for further analysis. F4 maintained acceptable physicochemical properties during two months of refrigerated storage, with pH values ranging from 3.84 ± 0.038 to 3.98 ± 0.1, TSS of 8.10 ± 0.2 °Brix, and titratable acidity ranging from 0.25 ± 0.0057 to 0.21 ± 0.0058. F4 exhibited antioxidant activity (IC_{50} = 5.81 ppm), higher than the control (IC_{50} = 79.56 ppm), total phenolic content of 3.11 ± 0.0954 mg GAE/g, and moderate antidiabetic activity (32.24%). Brine shrimp lethality assay showed low mortality (10–20%) at 100–1000 ppm, indicating $LC_{50} > 1000$ ppm. F4 demonstrated high sensory acceptability with desirable physicochemical and functional properties, indicating its potential as a functional beverage.

Keywords: Carbonated Ready-to-Drink Iced Tea, Ceylon Black Tea, Functional Beverage, *Mimosa Pudica*

Lavulu *(Pouteria campechiana)*-Filled Milk Chocolate Bar with a Ganache Center

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The objective of this study was to formulate and assess the quality of a Lavalu (*Pouteria campechiana*)-based milk chocolate bar with a fruit-filled ganache. Lavalu is an underutilized tropical fruit rich in carotenoids, polyphenols, and antioxidants, making it suitable for use in functional confectionery products. Three formulations (F1, F2, and F3) were prepared by varying the proportions of Lavalu puree and white chocolate in the ganache filling, alongside a control (F4) prepared with white chocolate ganache without any Lavalu puree. Sensory evaluation was conducted using a five-point hedonic scale with 50 semi-trained panelists to identify the most acceptable formulation, which was then compared with the control for proximate composition (standard AOAC methods), sugar content (phenol-sulfuric acid method), antioxidant activity (DPPH radical scavenging assay, AOAC 2012.04), water activity, peroxide value, and microbiological quality. Among the formulations, F2 containing 10.3% Lavalu puree showed significantly higher ($p < 0.05$) acceptability than the control. F2 contained 3.30% moisture, 30.42% fat, 1.61% fiber, and 1.32% ash, comparable to the control with lower sugar content (43.00%) and lower hardness (750.60 g) than the control, resulting in improved texture and a moderate level of sweetness. F2 also exhibited higher antioxidant capacity than the control, with a lower IC_{50} (196.296 ppm vs. 338.003 ppm) and higher total phenolic content (2.787 vs. 2.400 mg GAE/g). Water activity was low (0.6027), and the product remained microbiologically safe with peroxide value consistently within acceptable limits (0.8267), indicating minimal oxidative deterioration. It can thus be concluded that Lavalu can be successfully incorporated into filled milk chocolate to produce a nutritionally superior functional confectionery product compared to the standard white chocolate-filled control.

Keywords: Fruit-based Ganache, Lavalu *Pouteria Campechiana*, Milk Chocolate

Breadfruit (*Artocarpus altilis*)-Jackfruit Seed Cracker with Hot Chilli Flavor: Nutritional and Functional Evaluation

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Crackers are widely consumed baked snack products valued for their crisp texture, long shelf life, and convenience. This study aimed to develop nutritionally enhanced reduced-gluten crackers by partially substituting wheat flour with breadfruit (*Artocarpus altilis*) flour and jackfruit seed flour while incorporating hot chilli as a natural flavoring agent. Three composite flour formulations (F1, F2, and F3) were prepared by varying the proportions of jackfruit seed flour and wheat flour while maintaining a constant amount of breadfruit flour. A control formulation (F4) was used for comparison. Sensory evaluation was conducted using a five-point hedonic scale with 50 untrained panelists, and the most preferred formulation (F2) was selected for further analyses. The F2 formulation (50 g breadfruit flour, 20 g jackfruit seed flour, and 30 g wheat flour) received significantly higher ($p < 0.05$) scores for appearance, aroma, color, texture, crispiness, flavor, aftertaste, and overall acceptability. Physicochemical analysis showed low water activity (0.60–0.61), low moisture content (2.47–3.60%), and high ash content (3907.0 ± 92.5 mg/100 g), indicating improved storage stability and mineral composition. Techno-functional properties, including water absorption capacity (3.09 g/g), oil absorption capacity (3.08 g/g), and bulk density (0.961 g/cm^3), demonstrated favorable characteristics for dough handling and product quality. Texture Profile Analysis indicated a hardness value of 719.60 g, while FTIR confirmed the presence of functional groups associated with starch, proteins, lipids, and dietary fiber. Microbiological analysis showed that total plate count and yeast and mold counts remained within acceptable safety limits. These findings demonstrate the potential of breadfruit flour and jackfruit seed flour for producing nutritionally improved reduced-gluten crackers with acceptable sensory, functional, and storage properties.

Keywords: Breadfruit Flour, Crackers, Functional Properties, Sensory Evaluation

Comparative Phytochemical Analysis of Spine Gourd (*Momordica dioica*) Tubers Subjected to Different Drying Methods and Solvent Extractions

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Spine gourd (*Momordica dioica*), locally known as Tumba Karavila, is a perennial dioecious climber native to South Asia. Although its fruits are widely consumed, the tubers remain underutilized despite their traditional use in Ayurvedic medicine. This study evaluated the proximate and phytochemical composition of spine gourd tubers subjected to freeze-drying and oven-drying. Fresh tubers, with an initial moisture content of 77.39 ± 0.02%, were frozen at −20 °C before freeze-drying and oven-drying at 40 °C. Dried samples were extracted ($n = 3$) using ethanol, ethyl acetate, petroleum ether, cold water, and hot water at a 5:1 solvent-to-sample ratio for 24 h. Total phenolic content (TPC), total flavonoid content (TFC), total tannin content (TTC), total alkaloid content (TAC), and total steroid content (TSC) were determined using Folin–Ciocalteu, Aluminium Chloride Colorimetric, Peri and Pompei, Harborne, and Liebermann–Burchard methods, respectively. Freeze-dried samples contained higher ash (4.24 ± 0.08%) and crude fiber (3.66 ± 0.01%) but lower fat (1.20 ± 0.07%) than oven-dried samples. Freeze-dried samples also exhibited significantly higher ($p < 0.05$) TPC and TFC across all solvent extracts. The highest TPC was observed in the freeze-dried cold-water extract (22.12 ± 0.61 mg GAE/g), while the lowest occurred in the oven-dried petroleum ether extract (2.66 ± 0.14 mg GAE/g). Similarly, the highest TFC was recorded in the freeze-dried cold-water extract (5.07 ± 0.71 mg RE/g), and the lowest in the oven-dried hot-water extract (1.30 ± 0.04 mg RE/g). Freeze-dried samples also showed significantly higher TTC ($p < 0.001$), with the highest value in the ethanolic extract (7.75 ± 0.25 mg GAE/g). Ethanol extracts yielded the highest TAC in both freeze-dried (7.98 ± 0.20 mg/g) and oven-dried (7.83 ± 0.16 mg/g) samples, with no significant difference ($p > 0.05$). The highest TSC was detected in the freeze-dried petroleum ether extract (8.81 ± 0.99 mg CE/g). Overall, freeze-drying more effectively preserved phytochemicals than oven-drying, supporting the potential of spine gourd tubers for functional food applications.

Keywords: Bioactive Compounds, Freeze-dried Samples, Oven-dried Samples, Spine Gourd, Underutilized Tuber

Marine Pectin Derived from *Spirulina maxima* Exhibits Prebiotic Potential by Modulating Gut Microbiota and Immune Responses in Zebrafish

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In this study, we investigated the effects of two types of bioactive pectins derived from the marine microalgae, *Spirulina maxima*, on the modulation of the gut microbial community and mucosal immune responses in a zebrafish model. Two isolated pectins were denoted as *S. maxima* pectin (SmP) and heat-treated modified SmP. Adult zebrafish (n = 40/group) were fed (3 times per day) with SmP and modified SmP (4% w/w) for 60 days at 4% of body weight. The modulation of the gut microbiota was investigated through metagenomics analysis. The results revealed Fusobacteria and Firmicutes as the most increased phyla in the SmP group, while in the modified SmP group, the phylum Tenericutes was increased compared to the control group. The most abundant bacterial family in the control group was *Fusobacteriace* (34%), which increased in the SmP-fed group (48%) and drastically decreased in the modified SmP-fed group (7%). Moreover, qRT-PCR results showed significant ($p \leq 0.05$) upregulation of immune-related genes in the gut, namely interferon-γ (ifn-γ), interferon (ifn), interferon regulatory factor 3 (irf3), myxovirus (mx), interleukin 6 (il6), superoxide dismutase (sod-1), and catalase (cat) in the SmP group. Goblet cell density and villi height also increased significantly ($p \leq 0.05$) in pectin-supplemented zebrafish compared to the control group, suggesting that Spirulina-derived pectin has the potential to improve intestinal morphometry. According to our findings, we suggest that Spirulina-derived marine pectin could modulate the gut microbial community, enhance the expression of immune-related genes, improve gut morphology, and exert positive effects on the host's immunity and overall health.

Keywords: Spirulina, Pectin, Gut Microbiome, Immunoregulation, Zebrafish

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