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Scientia et Innovatio: Vision to Venture

YSCMR 2025
YOUNG SCIENTISTS' CONFERENCE ON MULTIDISCIPLINARY RESEARCH- NIFS

Proceedings of the

YOUNG SCIENTISTS' CONFERENCE ON MULTIDISCIPLINARY RESEARCH

VIRTUAL INTERNATIONAL CONFERENCE

2025

Organized by
The Young Scientists' Association
National Institute of Fundamental Studies, Sri Lanka.

YSCMR 2025

Proceedings of the

Young Scientists' Conference on Multidisciplinary Research - 2025

Virtual International Conference

27th November 2025

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Sri Lanka.
www.nifs.ac.lk
Tel: +94 (0) 812 232 002
Email: ysa@nifs.ac.lk

Page setup & Cover page design

Dileep Sandakelum & Kaveesha Dilshajith

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ACKNOWLEDGEMENT

We are extremely proud to note the successful completion of the Young Scientists' Conference on Multidisciplinary Research, YSCMR-2025, organized by the Young Scientists' Association of the National Institute of Fundamental Studies (NIFS-YSA). Without the unanimous contribution by many, this event would not have been a success. Thus, we would like to express our deepest gratitude to all those who helped us in many ways!

We would like to thank the Chairman Professor Sanath Rajapakshe, Acting Director Professor Siril Wijesundara, Secretary Mr. C.I. Sakalsooriya, Editorial committee members and Advisory Committee, NIFS-YSA for their valuable guidance and encouragement.

We also thank the academic and non-academic staff members of the NIFS for the tremendous support rendered by them.

MESSAGE FROM THE CHAIRMAN
NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

It gives me a great pleasure to send this message in my capacity as the Chairman of the National Institute of Fundamental Studies (NIFS). Fundamental research, often called basic science, is driven by curiosity to understand the fundamental mechanisms of the natural world. Although it forms the basis of technological advances in applied science, its main goal is to develop and improve scientific theories for a deeper understanding of natural phenomena. Its results are shared widely for peer review and add to the global body of knowledge.

In a developing country like Sri Lanka, strengthening this knowledge base is vital and full of challenges. Access to the global collection of research is often restricted by costly subscriptions to academic journals, limiting local research capacity development. This makes an institution such as NIFS that is responsible for producing original knowledge, especially important. Recognition, whether national or international, cannot rely solely on quantitative scientometric measures but must be earned through work that shifts understanding and questions existing paradigms.

Young Scientists' Association (YSA) is a dedicated group of individuals comprised of postgraduate students, volunteers, and undergraduate students at the NIFS. This year's theme of the conference which is happening for the 07th time is "Vision to venture: Bridging Research Innovation and commercialization for a New global frontier". Scientific research has long been considered an essential input in the innovation process, as it provides the technology foundation for innovation activity, it improves R&D efficiency, and enhances the usefulness and economic value of patents. Currently, Sri Lanka requires innovative R&D contributions to re-stabilise and uplift the economy.

The convergence of research from diverse fields from food science and sustainable agriculture, molecular biotechnology, natural products chemistry, material sciences biodiversity to data science and artificial intelligence fosters creativity and drives ground breaking advances.

It is my fervent hope that YSCMR 2025 would create a forum for presenting and discussing valuable research findings leading to enriching experiences to all the participants.

I would also take this opportunity to express my appreciation to the Organizing Committee of the YMSCR 2025 and other individuals who have contributed their time and effort to make this event a success.

Thank you.

Professor Sanath Rajapakse
Chairman,
National Institute of Fundamental Studies,
Hanthana Road,
Kandy.

MESSAGE FROM THE DIRECTOR
NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

It is with great pleasure that I extend a warm welcome to all participants of the 7th Young Scientists' Conference on Multidisciplinary Research (YSCMR 2025), organized by the Young Scientists Association of the National Institute of Fundamental Studies. This year, we are excited to host this prestigious event as an international virtual conference on 27th November 2025, bringing together a global community of young researchers, scholars, and innovators.

The YSCMR conference has always been a platform for fostering collaboration, intellectual exchange, and the growth of early-career researchers and postgraduate students. We are thrilled to have received an outstanding collection of abstracts covering a wide range of disciplines. These include research on food science and sustainable agriculture, microbial systems, molecular biotechnology, and natural product chemistry. Additionally, we will be exploring cutting-edge advancements in advanced material science, energy technologies, and quantum innovations. Other key areas of focus will include earth, environment, and biodiversity studies, as well as developments in data science, artificial intelligence, and mathematical modelling.

The breadth of topics presented highlights the innovative spirit of the next generation of scientists, whose work is poised to address some of the most pressing challenges of our time. I have no doubt that the ideas and discoveries shared during this conference will contribute significantly to shaping the future of scientific research and application.

I would like to express my sincere gratitude to all the participants, speakers, and organizers for their dedication to making this conference possible. Your enthusiasm for advancing knowledge and fostering scientific inquiry is truly inspiring. I look forward to the engaging discussions, new ideas, and collaborative opportunities that will emerge from this event.

On behalf of the National Institute of Fundamental Studies, I wish you all a rewarding and successful experience at YSCMR 2025.

Thank you.

Professor D.S.A. Wijesundara
Director,
National Institute of Fundamental Studies,
Hanthana Road,
Kandy.

MESSAGE FROM THE ADVISORY COMMITTEE
NIFS - YOUNG SCIENTISTS' ASSOCIATION

It is with great pleasure that we present the Proceedings of the 7th Young Scientists' Conference on Multidisciplinary Research (YSCMR 2025), organized as an international virtual conference on 27th November 2025. This year, we come together under the inspiring theme, "Bridging Research, Innovation and Commercialization for a New Global Frontier". This annual gathering continues to serve as a significant platform for postgraduate students, early-career researchers, and emerging innovators to share their scientific contributions, exchange ideas, and build meaningful collaborations across disciplines.

This year's conference has attracted a diverse and inspiring collection of abstracts, reflecting the conference theme, and a wide spectrum of fields, including:

- Food Science and Sustainable Agriculture
- Microbial Systems, Molecular Biotechnology, and Natural Product Chemistry
- Advanced Material Science, Energy Technologies, and quantum Innovations
- Earth, Environmental, and Biodiversity
- Data Science, Artificial Intelligence, and Mathematical Modelling

These themes highlight the increasing importance of integrated research approaches in addressing global challenges, fostering scientific innovation, and steering society toward more sustainable and technologically advanced futures. Each contribution in this proceedings volume embodies the dedication, curiosity, and scientific rigor that define the next generation of researchers.

We congratulate all contributors for their valuable submissions, and commend the organizing committee for their commitment to creating a dynamic and inclusive platform for multidisciplinary scientific communication. We also extend our appreciation to reviewers, mentors, and partner institutions whose support has helped uphold the academic quality of this conference.

As you explore the abstracts within this volume, we hope you gain insight into emerging research directions and find inspiration for future collaboration. We firmly believe that the ideas exchanged at YSCMR 2025 will continue to grow, evolve, and contribute meaningfully to scientific progress worldwide.

We wish all participants continued success in their research journeys and look forward to seeing the advancements that will emerge from this vibrant and talented community of young scientists.

Advisory Committee,
7th Young Scientists' Conference on Multidisciplinary Research (YSCMR 2025)

MESSAGE FROM THE EDITOR-IN-CHIEF, YSCMR - 2025

It is a great pleasure for me to say a few words on the occasion of the Young Scientists' Conference on Multidisciplinary Research 2025 (YSCMR 2025). The Young Scientists' Association of NIFS (NIFS-YSA) has organized this annual research conference for the 7th consecutive year as a platform for postgraduate students and early career scientists to disseminate their research findings. This year submissions were invited under the following sub-themes: Food and Sustainable Agriculture, Microbial Systems, Molecular Biotechnology, and Natural Product Chemistry, Advanced Material Science, Energy Technologies, and Quantum Innovations, Earth, Environment, and Biodiversity and Data Science, Artificial Intelligence, and Mathematical Modelling.

This yearly conference has continued to garner popularity among the local postgraduate research students as it is reflected in the increasing number of submissions. Although we received 257 submissions this year, only 192 were selected for presentation in the conference based on the outcome of the double-blind peer review process. YSCMR-2025 conference tracks are arranged into 02 technical sessions to find common interest and create synergy among different scientific disciplines.

I would like to take this opportunity to pass on my earnest gratitude to the conference organizing committee of YSCMR-2025 who contributed immensely to the success of this conference. As the Editor-in-Chief for this year's event, I would like to convey my sincere gratitude to all associate editors and peer reviewers for their time and effort.

I sincerely hope that YSCMR-2025 will be a memorable scientific experience to all the participants.

Prof. Nazrim Marikkar
Editor-in-Chief
Young Scientists' Conference on Multidisciplinary Research 2025,
National Institute of Fundamental Studies, Hanthana Road, Kandy.

MESSAGE FROM THE CONFERENCE ORGANIZERS
YSCMR-2025

It brings us immense pride to share this message on behalf of the Organizing Committee of the Young Scientists' Conference on Multidisciplinary Research 2025 (YSCMR-2025), organized by the Young Scientists' Association of the National Institute of Fundamental Studies (NIFS-YSA) for the 7th consecutive year. Established in 2018, the NIFS-YSA has remained committed to empowering young scientists through opportunities for leadership, research exposure, professional development and collaborative engagement.

YSCMR has progressed remarkably from its origins as an institutional level symposium to becoming an internationally recognized scientific conference. This year, YSCMR 2025 continues its legacy under the conference theme "*Scientia et Innovatio: Vision to Venture – Bridging Research, Innovation and Commercialization for a New Global Frontier*". To strengthen the scientific focus of the conference, this year we have refined the previous track structure and introduced five well-defined thematic tracks, allowing participants to engage within more specialized research domains as,

1. Food Science and Sustainable Agriculture
2. Microbial Systems, Molecular Biotechnology and Natural Product Chemistry
3. Advanced Material Science, Energy Technologies, and Quantum Innovations
4. Earth, Environment and Biodiversity
5. Data Science, Artificial Intelligence and Mathematical Modelling

As a result, we have received an overwhelming 257 abstract submissions, which is carefully evaluated by a dedicated panel of reviewers through a double-blind process. Of these, 192 abstracts were accepted, 107 for oral presentations and 85 for speed talks. The conference will be held in a virtual format with 13 dedicated technical sessions.

Organizing an event of this scale brings numerous challenges, yet the unwavering commitment and teamwork of our research assistants and volunteers at NIFS have been made to the success of YSCMR 2025 and we extend our sincere appreciation for their invaluable contributions. We would also like to express our sincere appreciation to the Chairman of NIFS, the Director of NIFS, the Advisory board of YSA, the Editor-in-Chief, and the Editorial Board members for their unwavering support and guidance throughout the process. Our gratitude also extends to the respected panel of reviewers, technical session chairs, and NIFS scientists, who played a crucial role in making this event a reality. Special thanks go to the Science Education and Dissemination Unit (SEDU) and the IT Division of NIFS for their support in organizing and managing the conference sessions.

We are honoured to welcome our esteemed Keynote Speaker for this year and we extend our heartfelt appreciation to Mr. Nalaka Vidanagamachchi, for accepting our invitation and delivering insightful, timely addresses at this year's conference. We also extend our congratulations all the presenters of YSCMR 2025 and sincerely hope that this conference will provide a platform for networking, knowledge sharing, and collaborative research that will inspire young scientists worldwide. Thank you all for making YSCMR 2025 a remarkable success.

Mr. C. Ilangarathne & Ms. H. Narampanawa
Co-chairs, YSCMR-2025

Mr. K. Premasiri & Ms. S. Sewwandi
Co-chairs, YSA-NIFS-2025

MESSAGE FROM THE KEYNOTE SPEAKER

It is a privilege to deliver the keynote address at *Scientia et Innovatio*: Vision to Venture Bridging Research, Innovation and Commercialization for a New Global Frontier, the 7th annual conference of the Young Scientists′ Association (YSA) of the National Institute of Fundamental Studies (NIFS).

My journey with NIFS began more than three decades ago, when I was invited by the legend and visionary Professor Cyril Ponnamperuma to join the Institute of NIFS as a Pre-Research Assistant (PRA). During that time, I was exposed to research and the pioneers who laid the foundation for scientific exploration in Sri Lanka. Those early years at IFS not only shaped my curiosity but also inspired me to harness technology in a way that allows me to do work I believe is great to stay hungry, stay curious, and have the courage to change the world for the better.

Since then, I have witnessed how the foundation of scientific inquiry and creativity can evolve into innovations that redefine industries and improve lives. Today, as the world enters a new era of global collaboration and rapid technological transformation, the bridge between research and real-world impact has never been more vital.

My keynote, "Engineering the Future: From Innovation to Product Creation," explores how ideas born in research can become products that shape our collective future. True innovation happens when engineering, design, and purpose come together when we move from the "what if" of research to the "what works" of creation.

As Steve Jobs once said, "Design is not just what it looks like and feels like. Design is how it works." That timeless idea continues to guide those of us who believe innovation is not only about invention but about making things that truly matter.

I commend the YSA and NIFS for cultivating the next generation of thinkers, builders, and dreamers who will lead Sri Lanka and the world toward a more sustainable and innovative future. I wish all participants a rewarding, inspiring, and forward-looking YSCMR 2025.

Nalaka Vidanagamachchi
System Architect
Apple Inc, Cupertino,
California, USA.

List of Abstracts

Advanced Material Science, Energy Technologies, and Quantum Innovations

Paper ID: CMT_21

SCAPS-1D based design and temperature-dependent performance analysis of high-efficiency tandem solar cells for extraterrestrial and terrestrial applications **2**
C.S. Wijesinghe[1], M.L.C. Attygalle[1]*

Paper ID: CMT_22

Influence of boron incorporation on the properties of faujasite zeolites **3**
M.A.K. Madhumekala[1], W.M.A.T. Bandara[2], I.P.L. Jayarathne[1]*

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SCAPS-1D based design and temperature-dependent performance analysis of high-efficiency tandem solar cells for extraterrestrial and terrestrial applications

C.S. Wijesinghe[1], M.L.C. Attygalle[1*]

[1]*Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

[*]*lattygalle@sci.sjp.ac.lk*

In this study, two advanced tandem solar cell models were designed using SCAPS-1D software and their performance and efficiency was evaluated under AM0 (sunlight at space) and AM1.5G (sunlight at the surface of the Earth) spectra across various temperature ranges. In addition to using space related applications (space villages and missions), the cells demonstrate strong performance even in terrestrial environments and can therefore be applied in solar power systems on earth with high efficiencies. The dual-purpose design highlights the increasing necessity of highly developed photovoltaic technologies in catering to the planetary energy needs as well as at the same time fulfils the peculiarities of the generation of power supply in outer space. The efficiencies of the developed cell models are as follows: The ZnTe – Perovskite (SnOx/PCBM/2D-MAPI/3D-MAPI/PEDOT) tandem model was tested at 323 K and 358 K temperatures. Under AM 1.5G illumination, the model achieved an overall efficiency of 19.4% at 323 K and 18.8% at 358 K. Under the AM0 spectrum, the efficiencies recorded were 17.9% at 323 K and 17.3% at 358 K. The Perovskite (SnOx/PCBM/2D-MAPI/3D-MAPI/PEDOT) – CIGS/GaAs tandem model was evaluated at 323 K and 358 K. Under AM 1.5G, it demonstrated an overall efficiency of 31.8% at 323 K and 29.8% at 358 K. Under the AM 0 spectrum, the recorded efficiencies were 29.3% at 323 K and 27.4% at 358 K. At a lower temperature 253K, ZnTe–Perovskite cell maintained a stabilized performance across both AM1.5G and AM0 spectra. But the Perovskite–CIGS/GaAs cell failed to achieve reasonable efficiency mainly due to decrease in carrier mobility, increased resistive losses, and increased carrier recombination at low temperatures. A confirmation of promising performance across temperature ranges in the tandem models can be observed through the simulation results. Highest efficiency is demonstrated by the Perovskite-CIGS/GaAs tandem cell. These findings contribute to designing resilient, stable power generation solar cells for space applications despite extreme conditions.

Keywords: *Extraterrestrial, perovskite, radiation, tandem solar cell, temperature*

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Influence of boron incorporation on the properties of faujasite zeolites

M.A.K. Madhumekala[1*], W.M.A.T. Bandara[2], I.P.L. Jayarathne[1]

[1]*National Institute of Fundamental Studies, Hanthana, Sri Lanka*
[2]*Faculty of Science, Peradeniya, Sri Lanka*

**kushanimadhumekala@gmail.com*

Partial isomorphous substitution of aluminum with tri- and tetravalent atoms in zeolite framework tetrahedral positions (T-atoms) is an effective method for tailoring zeolite properties and enhancing their catalytic performance. The primary objective of this study is to investigate the influence of boron incorporation on the particle size, morphology, and crystallinity of Faujasite (FAU) zeolites. In this study, Boron-aluminum substituted Faujasite ([B]-FAU)-type zeolites were synthesized using a microwave-assisted method and sodium dodecyl sulphate as template, with a molar composition of 4 SiO_2: y H_3BO_3: x Al_2O_3: 5.5 Na_2O: 0.2 SDS: 190 H_2O, where y and x values were adjusted to achieve the desired boron and aluminum ratios for each sample. The obtained materials were characterized using various techniques: Powder X-ray Diffraction (PXRD), Scanning Electron Microscopy (SEM), Infrared (IR) Spectroscopy as well as Raman Microscopy. PXRD and SEM analyses revealed a trend of decreasing crystallinity in the FAU-type zeolites as the concentration of framework boron (B^{3+}) increased. This suggests that higher levels of boron substitution negatively impact the structural ordering of the zeolite material. FT-IR and Raman spectroscopy confirmed the presence of six-membered rings in the [B]-FAU zeolites. Specifically, a higher proportion of boron atoms were observed to be integrated into framework-related deformed hexagonal structure within [B]-FAU zeolites. The incorporation of boron into FAU zeolite with structure directing agents, results in reduced crystallinity of the B/Al-FAU crystallites compared to unsubstituted FAU, where high boron concentrations can create defects within the crystal structure which act as nucleation sites for amorphous phases. Despite this reduction in crystallinity, the fundamental structure of the FAU zeolite remains unchanged, as the boron atoms are embedded within its framework.

Keywords: *Borosilicate, characterization, microwave-assisted, sodium dodecyl sulphate, structure*

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Dialium ovoideum natural dye for cost-efficient solar energy conversion

D.M. Saruwage[1], D.N. Udukala[3], M.M. Farhath[1*], T. Jaseetharan[2]

[1]*Department of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, 32200, Sammanthurai, Sri Lanka*
[2]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, 32200, Sammanthurai, Sri Lanka*
[3]*College of Chemical Sciences, Institute of Chemistry Ceylon, 10100, Rajagiriya, Sri Lanka*

[*]*mmohamed@seu.ac.lk*

Solar energy is the most abundant renewable energy source and the dye-sensitized solar cell (DSSCs) is one of the third-generation solar energy conversion devices. Commercially available dyes are used as sensitizers in DSSCs which are relatively high-cost materials. *Dialium ovoideum* is an endemic plant of Sri Lanka, grows in the semi-dry zone of the country. The objective of this study is to develop and optimize a cost-effective DSSC utilizing natural dye extracted from *Dialium ovoideum*, with particular emphasis on determining the optimum dye concentration to maximize the cell efficiency. Solar cells were fabricated with the configuration of FTO/TiO_2 P90/TiO_2 P25/natural dye/electrolyte/counter electrode. The TiO_2 P90 layer was deposited by spin-coating, while TiO_2 P25 layer was prepared by doctor-blade method and the sensitization process was caried out by immersion of the electrode in dye solution. Current-voltage characterization was performed under the illumination of 100 mW cm^{-2} with AM 1.5 spectral filter. A highest power conversion efficiency of 0.59% has been achieved which is corresponding to the dye solution with 0.01 g of dye in 5 ml of solvent. UV-Vis optical absorption spectra and FTIR (Fourier-transform infrared) analysis confirm the successful deposition of the natural dye on the surface of TiO_2, which is a critical step in the fabrication of DSSC. 1624 cm^{-1} is related to C=O stretching or C=C stretching in aromatic rings, which indicate the presence of plant dye's carbonyl or aromatic structure. Scanning electron microscopy (SEM) analysis reveals a highly porous nanostructure of the TiO_2 electrode, which is essential for maximizing dye adsorption and facilitating efficient electron injection. This study highlights the feasibility and potential of using *Dialium ovoideum* as a natural dye source in DSSCs, paving the way for further advancements in sustainable solar cell application.

Keywords: *Dye sensitized solar cells, electron injection, natural dye, renewable energy*

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Synthesis and characterization of bismuth triiodide (BiI_3) nanoparticles toward biomedical applications as computed tomography contrast agents

R.M.H.H. Rathnayaka[1], M.S. Kandanapitiye[2], M.N.M. Farhath[1*]

[1]*Department of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka*
[2]*Department of Nano Science Technology, Wayamba University of Sri Lanka*

**mmohamed@seu.ac.lk*

Bismuth stands out as the heaviest stable non-radioactive element, featuring excellent X-ray attenuation capabilities and relatively lower toxicity in comparison to other heavy metals. Despite the potential advantages of nanoparticulate contrast media, computed tomography (CT) contrast media development has been at a standstill for a long time, with conventional agents suffering from limitations of short circulation times, release of toxic breakdown products, and immediate adverse effects. The bismuth triiodide (BiI_3) nanoparticles were prepared with the objective of developing CT contrast agents for biomedical imaging. The combination of bismuth (Z = 83) and iodine (Z = 53) is expected to produce synergistic enhancement in X-ray attenuation. Solution-phase synthesis pathways provided phase-pure BiI_3 nanoparticles with quasi-spherical morphology and layered rhombohedral crystal structure (R-3 space group) in the 55-65 nm size range, as confirmed by XRD and TEM analysis. Thermogravimetric analysis revealed exceptional thermal stability, demonstrating minimal weight loss up to 300 °C, indicative of robust structural integrity. Hence, further investigations should focus on size-reduction methods to reach the renal clearance threshold (~5-6 nm), along with biocompatible coating strategies such as PEGylation to enhance circulation time and colloidal stability. These findings establish BiI_3 nanoparticles one step closer to realization as next-generation computed tomography contrast agents.

Keywords: *Biomedical imaging, nanoparticles, synergistic, x-ray attenuation.*

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Development and comparative evaluation of alginate and pectin-based active films incorporated with *Macaranga peltata* leaf extract as sustainable films

W.M.S.P. Siriwardhane[1], D.M.D. Bhagya[1*], G.K. Pamunuwa[1]

[1]*Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka*

[*]*dilkuma9@gmail.com*

This study focused on developing and evaluating biodegradable active films based on alginate (A) and pectin (P), incorporated with *Macaranga peltata* Leaf Extract (MPLE), for possible usage in sustainable food packaging. Rising demand towards sustainable materials has focused attention on natural biopolymers like alginate and pectin for their film-forming ability and biodegradability. MPLE, rich in phenolic substances, was utilized as a functional additive to enhance the antioxidant ability of the films. Films were prepared through solvent casting method using biopolymer solutions plasticized with sorbitol and calcium chloride applied as a crosslinking agent. MPLE was incorporated at concentrations varying from T1 (A/P + no MPLE), T2 (A/P + 1% MPLE), T3 (A/P + 2% MPLE) and T4 (A/P + 3% MPLE) as treatments. The films were characterized with regard to physical, optical and antioxidant properties. Film thickness measurements showcased no significant ($p < 0.05$) differences among treatments. Water solubility resulted that pectin films, especially at higher MPLE levels (T4), reflected lower solubility (37.281 ± 0.17), indicating stronger intermolecular bonding and water resistance. Swelling ratio (SR %) varied along the treatment, with alginate films typically showing higher SR%, while T4 alginate displayed the lowest (40.415 ± 0.274), possibly due to MPLE-induced crosslinking. Considering the functional properties, the pectin film under the T4 treatment demonstrated the highest total phenolic content (78.86 ± 0.030). Similarly, the DPPH radical scavenging activity of the pectin T4 film was also the greatest (78.88 ± 0.320), reflecting its remarkable antioxidant potential. Pectin films showed better clarity, higher whiteness, and lower opacity, whereas T4 alginate became opaquer potentially due to plant extract accumulation. Collectively, pectin films showed higher phenolic content, antioxidant activity, water resistance and visual appeal than alginate. The reduced solubility of calcium chloride cross-linked pectin indicates its suitability for controlled or slow bioactive release, benefiting active packaging applications. This study supports using plant extracts in sustainable biodegradable packaging alternatives.

Keywords: *Active packaging, antioxidant, biodegradable films, biopolymers, crosslinking*

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Variation of critical temperature of the Ising model with different sizes of structural connectivity matrices obtained from EEG data

Khadeeja Thahir[1], Sivayini Kandeepan[1*]

[1]*University of Sri Jayewardenepura, Sri Lanka*

[*]*ssivayini@sjp.ac.lk*

Understanding the relationship between the brain's structure and its dynamic behaviour is a fundamental challenge faced in computational neuroscience. This study explores how the critical temperature of the Generalized Ising Model (GIM), which is a statistical model used to represent interacting systems, varies with different sizes of structural connectivity matrices derived from EEG data. At the critical temperature (T_c), the system undergoes a phase transition, from an ordered state to a disordered state, mirroring how the brain balances stability and flexibility for efficient information processing. Lead field matrices for electrode configurations of 16, 32, 64 and 128 channels were used to generate simulated EEG data. These configurations were selected because lead field matrices were available for these systems sizes, allowing consistent analysis across realistic EEG data. Structural connectivity matrices were calculated using the phase synchronization method and normalized to maintain comparability between systems. The GIM was implemented through Monte Carlo simulations across a temperature range to obtain susceptibility and identify critical temperature points. Multiple initial conditions were tested to ensure stable and unbiased outcomes. Results showed a linear relationship ($R^2 = 0.9971$) between critical temperature and the number of electrodes, validated against empirical EEG-based connectivity trends. This suggests that as network complexity increases, the dynamics approach criticality more gradually, highlighting how structural scale modulates phase transition behaviour. These findings align with established theories of neural criticality, offering insights into how the brain transitions between cognitive states. Future directions include applying this framework to real EEG datasets and high-density connectomes to evaluate scalability and explore how pathological disruptions may shift critical dynamics. The outcomes reinforce the relevance of spin-based models for probing the structural-functional interplay underlying large-scale brain dynamics.

Keywords: *Brain dynamics, critical temperature, electroencephalography, phase transitions, susceptibility*

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Catalyst-assisted silica production from rice husk

S. Thanusha[1*], M.F. Nawas[1]

[1]*Department of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai*

**s.thanushathanu@gmail.com*

Silica has a wide range of applications in construction, food, electronics, health, and research sectors. It is also extensively used in pharmaceutical, chemical, and agricultural industries. Traditionally, silica is obtained from minerals such as sand or quartz through metallurgical processes. However, these conventional methods are energy-intensive, rely on non-renewable resources, and often cause environmental pollution during extraction. Therefore, finding alternative, sustainable, and energy-efficient sources for silica production has become essential Biomass waste materials, such as rice husk, offer a promising renewable source for silica extraction. In Sri Lanka, the large-scale cultivation of paddy generates significant amounts of rice husk waste, which can be converted into rice husk ash (RHA) and used as a silica precursor. This study focused on developing an environmentally friendly and efficient method for extracting silica from RHA while exploring the use of catalysts to improve yield and reduce energy consumption. The RHA preparation process included washing, drying, and combustion of rice husk at temperatures ranging from 400°C to 600°C, both with and without catalysts such as zinc and sand. Silica extraction was carried out by dissolving the RHA in 1N NaOH, followed by boiling, filtration, and precipitation with 1N HCl to form silica gel. The obtained product was purified, washed, and stored in airtight containers. FTIR analysis was conducted to identify the bonding characteristics of the extracted silica, while XRD analysis is ongoing. Combustion above 500°C yielded grey ash due to complete burning, while temperatures below 500°C resulted in partially burned residues. The silica yield at 600°C varied as follows: 5.400 g without any catalyst and sand, 6.200 g with 1.000 g zinc, 7.400 g with 2.000 g zinc, 9.600 g with 4.000 g sand, and 10.200 g with 5.000 g sand. The results indicate that sand and zinc catalysts enhanced combustion efficiency and silica yield. Thus, rice husk represents a valuable renewable resource for sustainable silica production, reducing energy requirements and environmental impact.

Keywords: *Bio-mass, combustion, energy consumption, purification, temperature*

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Source reconstruction of EEG data and inferring the structural connectivity

A.M. Musaraf[1], Sivayini Kandeepan[1*]

[1]*Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

[*]*ssivayini@sjp.ac.lk*

Source reconstruction of electroencephalography (EEG) data and inferring the underlying structural connectivity are critical steps in understanding brain dynamics and connectivity patterns. In this study, various methodologies and techniques for source reconstruction and parcellation of EEG data were explored. The primary challenges with EEG parcellation that this research attempts to solve are selecting a suitable tool, data preprocessing, source reconstruction, spatial variability, and selecting suitable parcellation methodologies. The Brainstorm toolbox in MATLAB was utilized to process raw EEG data efficiently, implementing a robust pipeline tailored for accurate source localization and parcellation. Minimum Norm Estimation (MNE), Dynamic Statistical Parametric Mapping (dSPM), Dipole fitting, and sLORETA (Standardized Low Resolution Brain Electromagnetic Tomography) techniques were applied to reconstruct neural sources from scalp EEG signals derived via OpenMEEG. These methods provide reliable localization of brain activity while accounting for challenges such as noise and volume conduction effects. Furthermore, parcellation was conducted using anatomical and functional approaches, including the Desikan-Killiany (DK) atlas, Desikan-Killiany-Tourville (DKT) atlas, and region-based parcellation, to divide the cortical surface into meaningful regions of interest (ROIs), enabling precise mapping of localized brain activity. Source reconstruction and parcellation were completed using MATLAB and the Brainstorm toolbox. Functional connectivity between brain regions was then assessed using coherence and correlation analyses, resulting in NxN connectivity matrices based on the Destrieux atlas. The methodology provides a systematic approach to reconstruct neural activity and understanding connectivity, offering a platform for further investigations into neurological disorders and cognitive functions.

Keywords: *Electroencephalography, inverse techniques, source localization, parcellation*

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Development of Pt free counter electrode for dye sensitized solar cells using composite of graphite, graphene quantum dots and MnO_2

T.M.H.G Thilakarathna[1,2*], G.K.R. Senadeera[1,2], M.A.K.L. Dissanayake[2], J.M.K.W. Kumari[2], P.U. Sandunika[2]

[1]*Department of Physics, Open University of Sri Lanka, Nawala, Sri Lanka*
[2]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*harshanag25@gmail.com*

Dye-sensitized solar cells (DSSCs) represent a low-cost, flexible, and environmentally friendly alternative to conventional silicon-based solar cells. In light of the growing global energy demand and the depletion of fossil fuel resources, DSSCs have emerged as a promising technology for sustainable and renewable energy generation. Platinum-coated counter electrodes (CEs) are typically used in DSSCs due to their excellent catalytic activity, which contributes to high power conversion efficiencies. However, the high cost of platinum substantially increases the overall cost of the device, highlighting the need for affordable alternative materials to enable large-scale commercialization. This study focuses on optimizing CEs using composites based on carbonaceous materials to enhance the performance of DSSCs. The counter electrodes were fabricated using a combination of Sri Lankan vein graphite, manganese dioxide (MnO_2), and graphene quantum dots (GQDs). A series of DSSCs were constructed and tested with CEs containing different weight ratios of graphite to GQDs. The CE incorporating graphite and 0.1 mM GQD showed the best performance. Based on this optimized condition, MnO_2 was introduced into the composite, and the graphite-to-MnO_2 weight ratio was systematically varied. Among the fabricated devices, the DSSC employing a CE with an 8:2 graphite-to-MnO_2 weight ratio demonstrated the highest power conversion efficiency of 2.78% under standard illumination conditions (100 mW cm^{-2}, AM 1.5). This enhancement is attributed to the optimal synergy between the high electrical conductivity of the graphite/GQD matrix and the strong electrocatalytic activity of MnO_2. This combination facilitates efficient electron transport and effective reduction of triiodide (I_3^-) at the counter electrode, thereby significantly improving the overall device performance**.** Future studies will investigate the durability and large-scale fabrication potential of the graphite/ GQD/ MnO_2 electrode for practical solar energy applications

Keywords: *Carbonaceous materials, composites, electrocatalytic activity, power conversion efficiency, sustainable energy*

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Aligning faculty power demand with solar energy supply for efficient management

T. Kugaranan[1*], S.M.A.I. Dilrangia[1], A.G.H.T. Jayathissaa[1], M.U.M. Rizneea[1], L.T. Jayasuriya[1]

[1]*Department of Electrical and Electronic Technology, Faculty of Technology, Rajarata University of Sri Lanka, Mihintale, Sri Lanka*

**tkugaranan@tec.rjt.ac.lk*

The increasing demand for electricity and the growing reliance on renewable energy sources present significant challenges in maintaining a stable, cost-effective, and efficient power supply, especially within resource-limited educational institutions. In many academic environments, fluctuating energy availability and the high cost of electricity and diesel-based backup systems create a need for smarter, more adaptive energy solutions. This project addresses these challenges by developing a smart energy management system specifically designed for a faculty building. The proposed system integrates solar power generation, real-time monitoring, and advanced energy demand forecasting using predictive analytics, supported by IoT-based sensing and control, to optimize power distribution and usage. By utilizing historical solar energy generation data and electricity consumption, the system can accurately predict future power demands. It then categorizes electrical loads into three main groups critical, semi-critical, and non-essential based on operational priority and tolerance to load interruptions, allowing for prioritized energy distribution. During periods of limited solar generation or high demand, non-essential loads can be automatically shed or scheduled for later use through intelligent load shifting. This demand-side management approach helps reduce dependency on grid electricity and costly diesel generators. The system incorporates predictive analytics and real-time data collection through IoT-based sensors and monitoring tools, providing actionable insights for facility managers, enabling timely and informed decisions to maintain energy balance and avoid overloads or wastage. Preliminary system performance observations demonstrate improved energy efficiency, lowered peak demand, and enhanced sustainability in building operations when compared to conventional energy management practices. Overall, this approach showcases the potential of intelligent energy management systems and highlights the novelty of this approach to minimize operational costs, enhance the use of renewable energy, and promote sustainability within educational institutions. By adopting such smart technologies, universities and faculties can take a significant step toward achieving energy independence and environmental responsibility, while also serving as role models for sustainable energy practices.

Keywords: *Demand prediction, energy efficiency enhancement, load prioritization, smart energy management, solar power integration.*

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Comparative study on synthesis of carbon quantum dots from raw and activated coconut shell charcoal for photovoltaic applications

H.N. Edirisinghe[1], A.R. Kumarasinghe[1*]

[1]*Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

[*]*argk@sjp.ac.lk*

Carbon quantum dots (CQDs) have emerged as promising nanomaterials due to their excellent optical properties, environmental friendliness, and potential applications in optoelectronic devices such as solar cells. This study compares the synthesis and characteristics of CQDs derived from raw and KOH-activated coconut shell charcoal using a hydrothermal method. Activated charcoal was produced through chemical activation with 3 M potassium hydroxide, enhancing porosity and surface functionality, which improved CQD nucleation. The synthesized CQDs were characterized using UV–Vis spectroscopy, photoluminescence (PL), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and dynamic light scattering (DLS). Results revealed that activated charcoal–derived CQDs exhibited stronger and broader fluorescence, with a major emission peak at ~550 nm and a shoulder around 450 nm, compared to the weaker, narrow emission at ~400 nm from raw charcoal CQDs. DLS analysis showed a Z-average size of 324.9 nm with a polydispersity index (PdI) of 0.497 for activated charcoal CQDs, indicating improved size uniformity relative to the raw precursor (PdI = 0.590). UV–Vis spectra showed a sharp absorption peak at 271 nm in the activated sample, confirming π–π^* transitions of sp^2-hybridized carbon domains. Morphological analysis through SEM further supported these findings, revealing that activated charcoal–derived CQDs exhibited uniform, spherical particles (50–200 nm) with minimal residue, whereas raw charcoal–derived CQDs formed irregular, clustered aggregates below 200 nm, indicating incomplete carbonization. The enhanced optical performance of CQDs from activated charcoal is attributed to KOH-induced porosity and oxygen functionalization, which promote uniform particle formation and efficient light absorption. These CQDs can serve as light-harvesting or electron transport materials in dye-sensitized and perovskite solar cells, enhancing charge transfer and improving overall photovoltaic efficiency. The results confirm that activated coconut shell charcoal is a superior, sustainable carbon precursor for high-quality CQD synthesis.

Keywords: *Bio-mass derived carbon precursors, hydrothermal synthesis, KOH activation, size distribution.*

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DFT study of 9-cis and 11-cis retinal isomerization mechanisms

R.A.V.S. Abeysekara[1], T.K. Gunawardhana[2], G.M.S.T. Gajasinghe[3], M.A.C.M. Haniffa[1], B.S.W. Karunarathna[2*]

[1]*Department of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka*
[2]*Department of Chemistry, Faculty of Science, Eastern University Sri Lanka, Chenkalady, Sri Lanka*
[3]*Department of Chemical Sciences, Faculty of Applied Sciences, University of Sri Jayawardenapura, Gangodawila, Nugegoda, Sri Lanka*

[*]*karunarathnabsw@esn.ac.lk*

Retinal belongs to the retinoid family, the aldehyde form of vitamin A, cannot be found naturally in its pure form in food. It is formed as a metabolite in beta-carotene cleavage. Retinal can be found in different isomeric types such as all-trans, 9-cis, 11-cis and 13-cis retinal. Among these isomers, 9-cis and 11-cis are crucial for the vision of animals through the isomerization mechanism of 9-cis to all-trans and 11-cis to all-trans. However, the detailed isomerization mechanism of these isomers is not fully understood. In this study, Density Functional Theory (DFT) with B3LYP/6-31G (d) level of theory was used to study the isomerization of 9-cis and 11-cis retinal. The relative ground state energy values (related to all-trans) indicated the stability of retinal isomers as all-trans (0.00 kcal.mol^{-1}) < 9-cis (1.16 kcal.mol^{-1}) < 11-cis (4.91 kcal.mol^{-1}) in the vacuum phase. Both 9-cis to all-trans and 11-cis to all-trans isomerization were computed using potential energy surface analysis (PES) in ground state and the activation energies are 67.36 kcal.mol^{-1} and 60.88 kcal.mol^{-1} respectively. It can be argued that no isomerization will take place at the ground state due to relatively higher activation energy barrier (> 60 kcal.mol^{-1}). Upon photoexcitation, the energy landscape shifts significantly, with the barriers reducing to 23.84 kcal.mol^{-1} for 9-cis to all-trans isomerization and 20.88 kcal.mol^{-1} for 11-cis to all-trans isomerization. Excited state to ground state transition is suggested through the photoexcitation facilitating cis to all-trans isomerization. Based on the excited state to ground state energy gap and excited state activation energies in isomerization, 11-cis retinal can be identified as a primary chromophore compared to 9-cis retinal. This result is well agreed with the laboratory experimental findings in previous studies.

Keywords: *Activation energy, Density Functional Theory, photoisomerization, potential energy surfaces*

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Investigating the mechanical strength of graphene oxide-enhanced fiberglass composites

U.G.H. Sadewani[1], S.M. Gunawardana[2], A.V.R.S. Koswaththa[2], Y.M.I.B. Samarakoon[2*]

[1]*College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya, Sri Lanka*
[2]*Ceylon Graphene Technologies, Nanotechnology Park, Mahenwatta, Pitipana, Homagama*

[*] *ymibsamarakoon@gmail.com*

Glass Fiber-reinforced polymer (GFRP) composites are valued in aerospace, automotive, and marine industries for their low density, high strength, and easy processing. However, weak fiber-matrix adhesion leads to failures like cracking and debonding. Strengthening this interface is key to improving their mechanical and functional performance. Graphene oxide (GO), known for its remarkable mechanical properties, has emerged as a promising additive to reinforce composite matrices. In this study, GO synthesized using a modified Hummers method, followed by a washing process with diethyl ether and ethanol to remove excess moisture, was introduced into a polyester resin matrix using ultrasonication with ethanol as the dispersing solvent. Composites were fabricated with varying GO loadings (0%, 0.01%, 0.1%, and 1% by weight) using the hand lay-up technique with 300 gsm chopped fiberglass mats. GO dispersions were evaluated by UV-Vis spectroscopy, while viscosity tests confirmed improved processability at lower viscosities. Flexural testing (ASTM standards) assessed mechanical performance. The results demonstrated that reducing the moisture content of graphene oxide significantly improved its dispersibility within the polyester resin matrix. This enhancement was most evident in the 0.01% GO sample, which exhibited better distribution and fewer signs of agglomeration. Improving the dispersibility of GO is crucial for achieving uniform reinforcement, and efforts are currently underway to further refine both moisture removal techniques and dispersion methods to enhance the overall mechanical performance. Additionally, an increase in ductility was observed in the 0.01% and 0.1% GO samples compared to the control, indicating a potential trade-off between flexibility and tensile strength that may be advantageous for certain applications. In conclusion, optimizing GO concentration and dispersion is crucial for effective reinforcement. Further studies should explore improved dispersion methods and surface modifications to enhance bonding and mechanical performance.

Keywords: *Agglomeration, dispersibility, ductility, flexural, viscosities.*

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Development of an electromagnetic shielding thin film using natural rubber latex with embedded carbon nanotube mesh structure patterned by using sound waves

T.D.A. Wijethunga[1], D.T.D. Weerathunga[1*], R.A.D.D. Dharmasiri[2]

[1]*Department of Polymer Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

**dhammikaweerathunga@sjp.ac.lk*

In the modern world, electromagnetic Shielding materials (EMS) have become crucial for protecting electronic devices from electromagnetic interference (EMI). In this study, compounded natural rubber latex (CRL) embedded with multiwalled carbon nanotubes (MWCNTs) was used to create EMI shielding thin films. Here, patterning of CNTs within the compounded rubber latex polymer matrix using low-frequency sound waves (20 Hz and 120 Hz) during film formation was introduced as a novel approach. The influence of CNT pattern on the microstructure, mechanical, electrical, and EMI shielding properties of the nanocomposites was investigated. The films were prepared with CNTs loading of 0.001 phr and 0.005 phr, and patterning was achieved using a subwoofer-based setup. Characterization techniques, including Raman spectroscopy, SEM, TGA, tensile testing, four-probe conductivity, and shielding effectiveness measurements, were employed. The EMI SE was determined within the 1300–1475 MHz radio waves by using a nano Vector Network Analyzer (Nano VNA). The CNT samples subjected to sound waves showed significantly higher electrical conductivity and EMI SE values compared to the samples without sound waves. Notably, the film with 0.005 phr CNT patterned at 120 Hz showed the highest electrical conductivity of 0.008 S m-1 and best EMI SE value in the range of 10–14 dB. However, the reduction in tensile strength indicates that their mechanical properties have decreased after applying sound waves due to film inhomogeneity and potential CNT agglomeration. The Raman spectrum revealed that applying sound creates defects of the graphitic structure of CNTs. These results demonstrate that the application of sound waves for creating a conductive pattern of CNTs inside the rubber matrix is a scalable and energy-efficient method for enhancing EMI shielding in CNT-polymer composites. The developed CNTs–CRL composite film is a promising material that can be used as an alternative to traditional metal-based shielding materials.

Keywords: *Carbon nanotubes - compounded rubber latex composites, electrical conductivity, electromagnetic interference shielding effectiveness, nano vector network analyzer*

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Low-cost three-electrode potentiostat for electrochemical measurements

H.V.H.C. Dayananda[1], R.A.D.D. Dharmasiri[1*], W.K.I.L. Wanniarachchi[1], N.P.L.N. Palliyaguru[2]

[1]*Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*
[2]*Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

[*]*dhanu@sjp.ac.lk*

A potentiostat is an electronic device that is used to study the relationship between electricity and chemical reactions in electrochemistry. The high cost of commercially developed potentiostats provides a significant barrier to access for laboratory students and educators. This research mainly focuses on the design of a laboratory-scale low-cost three-electrode potentiostat device. The developed device is currently limited to use with the cyclic voltammetry (CV) electroanalytical technique. Potentiostat circuit, a simple graphical user interface (GUI), and the electrochemical cell are the main parts of the developed system. The final design was constructed on a printed circuit board (PCB) with low-cost components, including a 12-bit digital-to-analog converter (DAC), operational amplifiers, and an Arduino Nano microcontroller equipped with a 10-bit analog-to-digital converter (ADC). Higher DAC and ADC bits give better voltage and current resolution, improving accuracy and signal quality. This device operates in a voltage range -1 V to +1 V. The designed (GUI) allows users to adjust important experimental parameters such as scan rate (2×10^{-4} V s^{-1} - 2×10^{3} V s^{-1}), number of cycles (1 - 100), and feedback resistor values (330 Ω - 100 KΩ). The electrochemical cell consists of a low-cost screen-printed electrode with a 2 mm diameter carbon electrode, potassium ferricyanide [$K_3Fe(CN)_6$] as the standard redox couple, and potassium chloride (KCl) as the supporting electrolyte. The developed low-cost device successfully produced the expected oxidation and reduction peak shapes on the cyclic voltammogram for the 0.1 M potassium ferricyanide chemical solution at a scan rate of 0.08 V s^{-1}. This cyclic voltammogram shape is comparable (within 5% deviation) to a laboratory-grade potentiostat. The total cost of the developed potentiostat system is approximately $25, which provides a novel, cost-effective, and accessible solution for undergraduate electrochemical research. The Future work focuses on expanding to differential pulse and square wave voltammetry.

Keywords: *Cyclic voltammetry, graphical user interface, redox couple, scan rate, screen-printed electrode.*

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Implementing and testing of a prototype footstep power harnessing device

R.M.S.L. Rathnayaka[1*], G.A. Gunawardana[1], P.H.S. Harshana[1], T. Kugaranan[1], L.T. Jayasuriya[1]

[1]*Department of Electrical and Electronic Technology, Faculty of Technology, Rajarata University of Sri Lanka, Mihintale*

[*]*sanjaya@tec.rjt.ac.lk*

With the ongoing energy crisis in Sri Lanka, frequent power outages have become a major challenge in daily life. At the same time, the growing global demand for sustainable and renewable energy solutions calls for innovative alternatives. This project presents an electricity generating device that harnesses human locomotion, an often-wasted form of energy, as a renewable power source. The system operates on the piezoelectric effect, where specific materials generate an electric charge when subjected to mechanical stress. Piezoelectric transducers are embedded within specially designed tiles, intended for installation in high-footfall public areas such as train stations, shopping malls, and school corridors. When stepped on, these tiles produce an alternating current (AC) output proportional to the applied pressure, which is converted to direct current (DC) through a rectifier and stored in a rechargeable battery. The module was designed and tested at laboratory scale, and its performance evaluated under various conditions to determine practical feasibility. Unlike many previous studies limited to proof of concept, this research provides experimentally validated insights into optimizing energy capture and real-world deployment. The DC output stage was further simulated using MATLAB/Simulink, where four tiles were modelled as input sources. The simulation demonstrated effective regulation and storage of the combined energy in a battery system, allowing estimation of cumulative power output. Further material, structural, and design improvements could enhance power generation for large-scale deployment, while predictive modelling based on footfall frequency and population weight distribution can estimate expected energy production in high-traffic areas. This study demonstrates the potential of piezoelectric tiles as sustainable micro-energy sources and as a means to promote public awareness of renewable energy technologies. The concept is scalable and applicable to powering low-energy systems such as LED lighting, signage, and mobile charging stations in smart city environments.

Keywords: *Alternative energy, electricity generation, footstep power, piezoelectric effect*

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Optimization of activated Palmyrah shell charcoal -carbon nanotube composite towards low-cost counter electrodes for dye-sensitized solar cells

S.L.M.D.K.V. Samarathunga[1,2], M.I.U. Weerasinghe[1,2], G.R.A. Kumara[1]*

[1]*National Institute of Fundamental Studies, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*

**grakumara2000@yahoo.com*

Dye-sensitized solar cells (DSSCs) have emerged as attractive low-cost alternatives to traditional photovoltaic systems due to their ease of fabrication and promising efficiency. A critical component influencing DSSC performance is the counter electrode (CE), which facilitates electron transfer and electrolyte regeneration. Although platinum (Pt) is widely used as a CE material due to its excellent conductivity and catalytic activity, its high-cost limits large-scale application. In this study, an alternative composite CE was developed using activated Palmyrah shell charcoal (APSC) and carbon nanotubes (CNTs), aiming to provide a more affordable yet efficient solution. APSC was produced by carbonizing Palmyrah shells at 900 °C for 20 minutes, followed by repeated quenching to enhance its porous structure. The CE was fabricated via spray pyrolysis, using a mixture composed of 0.3 g APSC, 0.2 g CNTs, 0.05 g polyvinylpyrrolidone (PVP) binder, and 10 mL isopropanol. The resulting slurry was deposited onto preheated fluorine-doped tin oxide (FTO) substrates and sintered at 300 °C for 20 minutes. The TiO_2-based photoanode was prepared by spraying a TiO_2 suspension onto FTO glass, sintered at 500 °C, and sensitized with 0.3 mM N719 dye solution. A 0.20 cm² active area was used for each assembled device, incorporating a liquid iodide/triiodide (I^-/I_3^-) electrolyte. The DSC with the optimized APSC:CNT composite CE demonstrated a power conversion efficiency of 5.21%, surpassing the performance of pure APSC-based CE (2.47%) and approaching that of a standard Pt-based CE (5.79%). The device also achieved a short-circuit current density (J_{SC}) of 13.32 mA/cm², an open-circuit voltage (V_{OC}) of 0.63 V, and a fill factor (FF) of 0.52. The morphology and thickness of the fabricated CE were examined using Scanning Electron Microscopy (SEM), which revealed a uniform surface with a cross-sectional thickness of 94.16 µm**.** These findings highlight the potential of APSC-CNT composites as a low-cost, efficient, and sustainable replacement for platinum in DSSC technology.

Keywords: *Activated palmyra shell charcoal, Carbon nanotube, Counter electrode, Dye-sensitized solar cells, steam activation*

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Evaluating the necessity of lipid extraction prior to ^{13}C and ^{15}N stable isotope analyses of *Macrobrachium rosenbergii* muscle tissues in food web studies

S.S.U. Silva[1], U.A.D. Jayasinghe[1*], K.H.M.A. Deepananda[1], C.M. Jones[2]

[1]*Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Sri Lanka*
[2]*Centre for Sustainable Tropical Fisheries and Aquaculture, College of Science and Engineering, James Cook University, Australia*

[*]*asanka@fish.ruh.ac.lk*

Stable isotope analysis is a widely used technique in ecological studies to investigate food web dynamics, nutrient cycling, and habitat use. It measures natural variations in stable isotopes like carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) within biological tissues. As lipids are depleted in ^{13}C, chemical lipid extraction or mathematical correction of $\delta^{13}C$ values is necessary to ensure accurate dietary interpretation. This study evaluates the necessity of lipid extraction for *Macrobrachium rosenbergii* (giant freshwater prawn) muscle tissues by comparing it with the published lipid normalization techniques, marking the first such evaluation in a Sri Lankan reservoir context. Twenty-one *M. rosenbergii* samples were collected from four reservoirs in Sri Lanka during 2023-2024 period and each sample was analyzed for $\delta^{13}C$ and $\delta^{15}N$ isotope values before and after lipid extraction. Muscle tissues were oven-dried, ground, and lipid-extracted using methanol and chloroform, following Folch method. The $\delta^{13}C$ values of lipid-non-treated samples were separately corrected using arithmetic lipid normalization models. The results indicated that lipid percentages in muscle tissues ranged from 1.22% to 4.56%, and C: N ratios were higher in untreated samples (3.05–3.79) compared to lipid-treated samples (2.70–3.50). The paired t-test ($p = 0.996$) on arcsine transformed isotopic ratios revealed no statistically significant differences between lipid-treated and untreated samples. In addition, arithmetic normalization of lipid-untreated $\delta^{13}C$ values produced results comparable to lipid-treated values ($p = 0.892$), with a mean difference of -0.00297‰. These findings suggest that lipid extraction is not compulsory for $\delta^{13}C$ analysis in *M. rosenbergii* muscle tissues and that arithmetic normalization provides a time-efficient and non-destructive alternative. The findings offer practical value for future stable isotope studies in tropical freshwater systems, especially where sample volume is limited or destructive processing is not feasible.

Keywords: *C:N ratio, Folch method, isotopic fractionation, mathematical normalization*

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Diversity of odonates associated with rice field in the Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka

K.P.L. Arosha[1*], K.M.H. Piumal[1], U.G.D.S. Karunarathna[1], A.M.P.K. Dekandauwala[1], D.M.D. Dissanayake[1]

[1]*Faculty of Agriculture, Rajarata University of Sri Lanka*

**lakminiarosha191@gmail.com*

A preliminary survey of odonate fauna in the rice fields at the Faculty of Agriculture, Rajarata University of Sri Lanka, was conducted from January 19th to April 27th, 2024, to identify the species and study their reproductive behavior in the rice ecosystem. The study was carried out in a one-hectare rice field divided into eight plots (25×50 m²) using the belt transect method (Visual Encounter Surveys carried out 1m from each side of transect) during the day (8 to 10 am) and evening (3 to 5 pm), twice weekly. A total of 2674 individuals across 17 species were recorded (eleven species of the family Libellulidae and six species each of the Coenagrionidae and Platycnemididae). During the vegetative stage, 749 individuals were counted, representing 10 species, with a Margalef Richness Index (D) of 1.36, Shannon-Wiener Diversity Index (H) of 1.22, and Pielou's Evenness Index (e) of 0.53. The reproductive stage recorded 978 individuals encompassing all 17 species, with D = 2.32, H = 1.74, and e = 0.6. Similarly, during ripening stage 947 individuals belonging to 17 species, with D = 2.33, H = 1.62, and e = 0.57 observed. Reproductive behavior was observed in seven odonate species (two damselfly species and five dragonfly species), with the number of mating pairs differing among the vegetative, reproductive, and ripening stages of the rice crop. Notably, species such as *Brachythemis contaminata, Diplacodes trivialis, Orthetrum glaucum, Aethriamanta brevipennis, Crocothemis servilia, Neurothemis tullia, Pseudagrion microcephalum, Copera marginipes, Ischnura senegalensis,* and *Pseudagrion malabaricum* were present during all crop stages, demonstrating their adaptability to the changing habitat conditions of rice fields. The findings highlight the influence of the rice growth cycle on odonate diversity and reproductive behavior, with increased species richness and diversity during the reproductive and ripening stages. These periods likely provide more suitable conditions for odonates due to the greater availability of insect prey and water. The results underscore the role of rice fields as critical habitats for odonates and their potential in natural pest control. Further explorations are needed to study odonate behavior in rice ecosystem.

Keywords: *Behavior, dry-zone, odonata, rice ecosystem, species diversity*

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Assessment of drinking and irrigation water quality in a mountainous region of Sri Lanka: A case study from Mandaramnuwara

I.U.B. Athauda[1]*, L.M.K. Weligamage[1], B. Rathnayake[1], N.D. Mahalekam[1], C.P. Chandrarathne[1], R. Chandrajith[1], P. Vlahos[2], S. Anand[3], N. Nanayakkara[4], S. Hewapathiranage[5]

[1]*Department of Geology, Faculty of Science, University of Peradeniya, Sri Lanka*
[2]*Department of Marine Sciences, University of Connecticut, USA*
[3]*Division of Nephrology, School of Medicine, Stanford University, USA*
[4]*Centre for Research, National Hospital, Kandy, Sri Lanka*
[5]*Nephrology and Kidney Transplant Unit, National Hospital Kandy, Sri Lanka*

**isharaathauda94@gmail.com*

Mandaramnuwara, located at the base of the Piduruthalagala mountain range in the wet zone of Sri Lanka, has steep terrain and lacks dug wells. Drinking water is mainly sourced from streams fed by the Kolapathana Waterfall and natural springs, shared among households through pipelines or community tanks. This study analysed hydrogeochemical parameters in stream (n=9) and spring (n=2) samples. The weighted arithmetic index method (Kizar, 2018) was used to calculate the Water Quality Index (WQI) based on 12 parameters: pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), and major ions (Ca^{2+}, Mg^{2+}, Na^{+}, F^{-}, Cl^{-}, NO_3^{-}, SO_4^{2-}). Spring water was Ca-HCO_3^{-} type, with higher mean EC (282 µS/cm), TDS (142 mg/L), TA (149 mg/L), and TH (160 mg/L), indicating hard water. Stream water had lower values: EC (110 µS/cm), TDS (54.7 mg/L), TA (34.9 mg/L), and TH (49.1 mg/L). All parameters met Sri Lankan Drinking Water Standards (SLS 614:2013), though elevated nitrate in some stream samples suggests agricultural contamination. WQI values showed both sources were suitable for drinking. Stream water is mainly used for irrigation, and spring water is less utilized. Hence their suitability was evaluated using Residual Sodium Carbonate (RSC), Magnesium Hazard (MH), and Sodium Adsorption Ratio (SAR). Stream water had mean RSC (0.39 meq/L), MH (32.03%), and SAR (0.21), confirming suitability for irrigation. Spring water had values of 1.67 meq/L, 12.41%, and 0.10, indicating slightly higher RSC. Future research should focus on trace metals to assess potential health risks to the local population.

Keywords: *Magnesium hazard, residual sodium carbonate, sodium adsorption ratio, water quality index*

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Impact of water flow on phytoplankton diversity in watawala ella falls, wet zone of Sri Lanka

D.D.G. Kumarasinghe[1], H.A.C.C. Perera[1*], K.A.B.P. Perera[1], M.A.C.J. Wijeratne[1], S.P.P.M. Senadheera[1]

[1]*Department of Zoology and Environment Management, Faculty of Sciences, University of Kelaniya, Kelaniya, GQ 11600, Sri Lanka*

[*]*chinthap@kln.a.lk*

This study investigates the diversity and abundance of phytoplankton in relation to varying water velocities at three selected sites of Watawala Ella Falls, located in the wet zone of Sri Lanka. Characterized by fluctuating water flow and turbulence, this waterfall system provides a range of microhabitats for aquatic organisms. Five phytoplankton samples were collected from each site over six consecutive days in October 2024 using a 50 µm plankton net and preserved in Lugol's solution. A total of 14 phytoplankton species representing five phyla were identified across the sites. The results revealed a possible correlation between phytoplankton density and water velocity. The average velocity of each site was measured by using the floating method Site 01, with the highest velocity (0.25 m/s), had a moderate density (0.59 individuals/L); Site 02, with the lowest velocity (0.125 m/s), showed the highest density (1.06 individuals/L); while Site 03, with intermediate velocity (0.1667 m/s), had the lowest density (0.27 individuals/L). Site 02 exhibited the highest species richness (36 individuals) and a significant presence of *Cyanophyta* such as *Oscillatoria* and *Calothrix*, which are often associated with nutrient enrichment and organic pollution. This suggests a link between reduced flow velocity and the accumulation of pollutants, supporting conditions favourable for pollution-tolerant species. In contrast, Site 01 displayed a balanced composition of *Chlorophyta* and diatoms such as *Ankistrodesmus* and *Navicula*, indicative of moderately clean water. Site 03 showed the lowest species richness (15 individuals), due to low hydrodynamic disturbance. These findings indicate the influence of water velocity on the spatial distribution of phytoplankton communities.

Keywords: *Cyanophyta, Lugol's solution, phytoplankton, pollutants, water velocity.*

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Long-term environmental fallout from the X-Press Pearl disaster in Sri Lanka and its impacts on the blue economy

E. Gayesha[1], G.N. Kuruppu[1*], N. Dushyantha[2], S.M. Dassanayake[3]

[1]*Department of Industrial Management, Faculty of Business, University of Moratuwa, Sri Lanka*
[2]*Department of Applied Earth Sciences, Faculty of Applied Sciences, Uva Wellassa University, Passaara Road, Badulla, Sri Lanka*
[3]*Department of Decision Sciences, Faculty of Business, University of Moratuwa, Sri Lanka*

**gayithri@uom.lk*

In May 2021, the X-Press Pearl disaster off Sri Lanka's west coast released hazardous chemicals, plastic nurdles, and oil, constituting the country's worst maritime event. While immediate impacts have been documented, limited research has investigated the long-term consequences for coastal communities and the blue economy. This study examines community-perceived environmental and socio-economic consequences more than three years after the disaster, drawing on both primary and secondary sources. A qualitative research design was adopted, using purposive and snowball sampling across four severely affected coastal villages in Negombo—Dungalpitiya, Morawela, Sarakkuwa, and Browns Beach. Data were gathered through 52 unstructured, in-depth interviews (November 2024–January 2025), supported by field observations, photographic evidence, and secondary data. The thematic analysis revealed five key themes: 1) livelihoods of coastal communities, 2) location-based environmental impacts prior to the X-Press Pearl disaster, 3) health and environmental impacts after the X-Press Pearl disaster, 4) economic and financial impacts, and 5) government interventions in crisis management. Persistent plastic nurdle contamination, documented through field photography, continues to degrade coastal ecosystems. The loss of natural coastal aesthetics has undermined tourism and placed additional burdens on communities to clean up. Respondents reported a decline in fish populations and disrupted spawning grounds, reducing catches and threatening income and food security. Field observations revealed chemical and melted plastic residues, visible as white, cotton-like deposits on fishing nets, causing net damage. Respondents expressed concern about invisible environmental threats, referring to potentially lingering toxins in seafood and seawater, raising doubts about long-term contamination. These findings indicate that environmental fallout continues to impair ecosystems and livelihoods. Achieving effective recovery requires integrating community perspectives beyond mere technical measures. Strengthening coastal resilience requires inclusive governance, sustained ecological monitoring, and targeted blue finance strategies to restore economic and environmental integrity in Sri Lanka's coastal regions.

Keywords: *Coastal livelihoods, community perception, coastal resilience, governance, thematic analysis.*

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Mycorrhizal infections in seedlings of selected tree species used for restoration programs in Sri Lanka

M.G.N.T. Perera[1], G.A.D. Perera[1*]

[1]*Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka*

**anomap@sci.pdn.ac.lk*

Mycorrhizal infections in tree seedlings are important considerations when planning successful restoration programs. This study investigated the presence or absence of ectomycorrhizal (ECM) and vesicular-arbuscular mycorrhizal (VAM) infections, as well as the percentage ECM root infection and mantle length, in seedlings of four tree species— *Adenanthera pavonina*, *Macaranga peltata*, *Neolitsea cassia* and *Tamarindus indica*) (n = 3 – 5) — collected from a semi-urban area at the University of Peradeniya. In addition, the ECM root infections in thirty-one *T. indica* seedlings at varying ages (up to 70 days) were examined. Seedling height and root collar diameter (RCD) were measured along with canopy openness above the seedlings, and soil pH and electrical conductivity (EC). Results showed that ECM infections, characterized by the presence of a Hartig net in the root cortex and septate fungal hyphae, were found in all examined species (p = 0.084). However, the fungal mantle length (ML) was significantly greater in *M. peltata* and *A. pavonina* (p = 0.001). VAM infections, indicated by the penetration into cortical cells and presence of aseptate hyphae, were found only in *M. peltata* and *N. cassia.* Canopy openness was greater in sites where *M. peltata* and *T. indica* were collected, but the soil pH (7.201 ± 0.395 - 7.420 ± 0.072) was similar across all sampled locations. However, soil EC (102 ± 0 - 269.289 ± 116.176 µS cm^{-1}) varied significantly (p = 0.015) among species. Moreover, Both the % ECM infection and ML negatively correlated with EC (r = - 0.783 and r = - 0.551, respectively). Principal Component Analysis of the examined parameters in the 31 *T. indica* seedlings yielded five distinct seedling clusters, showing significant differences in average % ECM infection and ML (p = 0.02 and p < 0.001, respectively). In contrast, RCD, canopy openness, soil pH, and EC did not differ significantly among the clusters (p > 0.05). Both % ECM infection and ML in *T. indica* seedlings decreased with increasing seedling height (r = - 0.488 and r = - 0.584, respectively) and age (r = - 0.600 and r = - 0.474, respectively), suggesting that ECM colonization declines as seedlings mature. Species exhibiting both ECM and VAM associations such as *M. peltata* and *N. cassia* may have a higher potential for successful establishment in restoration sites. In species lacking VAM infections, ECM associations in younger seedlings likely play a crucial role in establishment and early growth. Further research is needed to explore changes in mycorrhizal associations with seedling age in other tree species.

Keywords: *Ectomycorrhiza, restoration programmes, seedling establishment, seedling height, VAM infection.*

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Developing a species recovery plan for *Eugenia haeckeliana* Trimen: a critically endangered, point endemic plant species in Sri Lanka

R.T. Dissanayake[1*], R.G.H. Ranil[1,2,3], W.N.D.S. Weheragoda[1], R.M.A.P.M. Rajatewa[4], S.S. Fernando[5], H.D. Jayasinghe[6], D.K.N.G. Pushpakumara[1], S.A.C.N. Perera[7], D.M.S.B. Dissanayaka[1], J.P. Eeswara[1]

[1]*Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka,*
[2]*Laboratory of Ecology and Environmental Management, Science and Technology Advanced Institute, Van Lang University, Ho Chi Minh City, Vietnam,*
[3]*Faculty of Applied Technology, School of Technology, Van Lang University, Ho Chi Minh City, Vietnam*
[4]*The Environmental Consultant, Educational and Rehabilitation Organization, 93/A18, 2nd Lane, Bandaranayakepura, Indigolla, Gampaha, Sri Lanka,*
[5]*Centre for Applied Biodiversity Research and Education, Doragamuwa, Kandy, Sri Lanka,*
[6]*Plant Taxonomy and Conservation Project, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka,*
[7]*Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*
**ag18042@agri.pdn.ac.lk*

Eugenia haeckeliana Trimen, a critically endangered species endemic to Sri Lanka, was recently rediscovered after 142 years, confined to a single, small population on private land in Weligama. Given its highly vulnerable habitat and limited number of individuals, urgent conservation action is needed. However, the absence of baseline data poses a major challenge to recovery planning. This study aimed to generate essential information to support the development of a species recovery plan. Sixteen 10 × 10 m plots were established to assess vegetation, ecological characteristics, and population structure. A total of 60 individuals were recorded, with diameters ranging from 1 to 6 cm, forming four distinct clusters. A detailed morphological description was compiled to aid future taxonomic studies. *Mimusops elengi* was frequently associated with *E. haeckeliana*, indicating possible ecological interactions valuable for conservation planning. Soil analysis revealed no significant difference in nitrogen, phosphorus, organic carbon, pH, and EC levels ($p > 0.05$) in the species' habitat compared to other sites. Propagation trials using stem cuttings and air layering, though not resulting in root formation, showed signs of callus development and sprouting, indicating potential for vegetative propagation. Ecological niche modelling identified 19 additional potential sites for future surveys or reintroduction efforts. Furthermore, a DNA extraction and PCR protocol was developed, yielding consistent monomorphic bands, laying the groundwork for future genetic studies. All observed individuals of *E. haeckeliana* exhibited symptoms of foliar disease, indicating a high prevalence of infection within the population. This study provides the first comprehensive population, ecological, and propagation data for *E. haeckeliana*, forming an essential foundation for its long-term conservation and the formulation of an effective recovery plan.

Keywords: *Conservation, endemic, niche modeling, population structure, propagation*

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Phytochemical profiling and antimicrobial activity of *Heterodermia* lichens collected from tea plantations in Sri Lanka

M.A.B.C.N. Bandara[1], R.G.U. Jayalal[2], I.U. Kariyawasam[1*]

[1]*Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*

[*]*isurufasi@sjp.ac.lk*

Lichen genus *Heterodermia* is known to produce bioactive secondary metabolites, yet information on their phytochemistry and antimicrobial potential is limited. The present study aimed to identify phytochemicals and antimicrobial activity of selected *Heterodermia* species isolated from tea bark in Sri Lanka, highlighting their potential in natural antimicrobial product development. Nine *Heterodermia* species; *H. comosa* (Eschw.) Follmann & Redòn, *H. dactyliza* (Nyl.) Swinscow & Krog, *H. isidiophora* (Nyl.) D.D. Awasthi, *H. japonica* (Sato) Swinscow & Krog, *H. microphylla* (Kurok.) Swinscow & Krog, *H. obscurata* (Nyl.) Trevis., *H. pellucida* (D.D. Awasthi) D.D. Awasthi, *H. propagulifera* (Vain.) J.P. Dey, and *H. speciosa* (Wulfen) Trevis was subjected to phytochemical analysis using Thin Layer Chromatography (TLC) of acetone extracts of lichens with solvent system G. R_f values, and colour reactions under UV light were recorded. Antimicrobial activity was assessed by disk diffusion assay against Gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*), Gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*), and fungus (*Candida albicans*) using acetone extracts of lichen. Chloramphenicol, Gentamicin, and Ketoconazole were used as the positive control for Gram-positive bacteria, Gram-negative bacteria, and the fungus, respectively, while acetone was used as the negative control. All assays were duplicated, and results were statistically analyzed using one-way ANOVA followed by Tukey's post hoc test ($p < 0.05$). TLC, confirmed the presence of atranorin, lesdainin, zeorin, and salazinic acid with antimicrobial properties in many species tested. All *Heterodermia* species showed antimicrobial activity against *Bacillus subtilis* and *Staphylococcus aureus*, with *H. speciosa* showing the highest inhibition zones (3.05 mm and 1.95 mm, respectively), while *H. japonica* recorded the lowest (0.65 mm and 0.80 mm). *Heterodermia* species exhibited no antimicrobial activity against Gram-negative bacteria or the fungus *Candida albicans*. The tested *Heterodermia* species exhibited notable antimicrobial potential, indicating their promise as natural sources of bioactive compounds.

Keywords: *Antibiotics, microbes, physciaceae, secondary metabolites*

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A preliminary study on the diversity and abundance of dragonflies in selected habitats at Padeniya, Kurunegala district, Sri Lanka

K.M.B. Weerakoon[1], R.R.M.U.N.B. Rathnayake[2*]

[1]*Faculty of Science, University of Ruhuna, Matara, Sri Lanka*
[2]*Department of Zoology, University of Ruhuna, Matara, Sri Lanka*

[*]*udaranipuna97@gmail.com*

Dragonflies (suborder Anisoptera: order Odonata), are widely regarded as important bioindicators of freshwater ecosystem health due to their sensitivity to environmental changes and reliance on aquatic habitats during their life cycles. Despite Sri Lanka's rich odonate fauna, many regions particularly in the North-western Province, including Kurunegala District remain underexplored in terms of species composition and habitat associations. This preliminary study aimed to document the diversity and abundance of dragonflies across three distinct sub-habitats, a home garden (HG), a paddy field (PF), and a water stream (WS) in Padeniya, Kurunegala District, Sri Lanka, from April to June 2025. Surveys were conducted along fixed transects using the Visual Encounter Survey method, and species were identified using photographic evidence and field guides, with a total of 24 transects surveyed over 18 hours per habitat to ensure adequate sampling coverage. Biodiversity indices including the Shannon-Wiener Index, Simpson's Diversity Index, and Evenness Index were calculated to assess community composition. A total of seven dragonfly species, all belonging to the family Libellulidae, were recorded. *Diplacodes trivialis* (n = 857), was the most abundant species, accounting for over 60% of total observations. Species richness and diversity were highest in the home garden habitat (H′ = 1.263; D = 0.649), followed by paddy fields (H' = 1.021; D = 0.393) and water streams (H' = 0.621; D = 0.390). Female-biased sex ratios were observed across habitats (HG 1.2:1, PF 3.2:1, WS 4.8:1), which may reflect reproductive behaviours linked to habitat use. The findings underscore the ecological significance of structurally diverse anthropogenic habitats like home gardens in maintaining dragonfly diversity, while the low diversity and high dominance in stream habitats may indicate environmental stress. This study provides essential baseline data and highlights the need for comprehensive ecological assessments, to guide freshwater biodiversity conservation in rapidly changing rural landscapes of Sri Lanka.

Keywords: *Bioindicators, dragonfly diversity, freshwater habitats, Odonata, Sri Lanka.*

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Rare earth element accumulations in South-eastern coastal beach placers, Sri Lanka

W.K.M.G. Kumarawansha[1*], A.M.N.M. Adikaram[1], T.B.N.S. Madugalla[1], N.P. Dushyantha[2], N.P. Rathnayake[3]

[1]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka,*
[2]*Department of Applied Earth Sciences, Faculty of Applied Sciences, Uva Wellassa University of Sri Lanka, Badulla,*
[3]*Department of Earth Resources Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka*

[*]*maheshikagayathri98@gmail.com*

The beach placers are major sedimentary-type deposits that have long been recognized as economically significant sources of rare earth elements (REEs). The southeastern (SE) coast of Sri Lanka hosts scattered beach placers, particularly concentrated near the low-energy environments such as lagoons and river mouths. These placers are characterized by black-coloured, fine to medium-grained laminated sediments, indicating favourable conditions for REE exploration, although it is planned to mine for heavy minerals. This study assessed the unexplored REE potential along the SE coast of Sri Lanka by evaluating beach placers. For this study, 21 sediment samples were collected from beach placers extending over 68 km along the SE coastline from Thampaddai to Arugam Bay during the dry period of the year. The samples were investigated for REE mineralogy and REE concentrations by using Fourier Transform Infrared (FTIR) spectrometer and Inductively Coupled Mass Spectrometer (ICP-MS), respectively. The average total REEs concentration (La-Lu, Y) in SE beaches ranges from 99.30 to 888.77 mg kg^{-1}. They show enrichment of some elements which are under light rare earth elements (LREEs: Pr, Ce, Nd) as well as heavy rare earth elements (HREEs: Gd, Dy, Y), potentially due to the presence of REE-bearing minerals, especially monazite, xenotime and zircon. Gd and Pr showed higher average concentrations of 85.23 mg kg^{-1} and 64.16 mg kg^{-1}, which are comparable to average crustal abundances of 3.80 mg kg^{-1} and 7.40 mg kg^{-1}, respectively, and also exceed those in the Pulmoddai beach placers of Sri Lanka. These findings indicate a higher concentration of HREE (31.11–226.94 mg kg^{-1}) in SE beach placers compared to current REE-bearing beach placers (Odisha: 5.0–28.0 mg kg^{-1}, Andhra Pradesh: 3.20–51.70 mg kg^{-1}) of India, emphasizing the need for further detailed investigation to assess their REE potential with respect to both LREE- and HREE-enriched minerals.

Keywords: *FTIR analysis, ICP-MS analysis, resource, scattered beach placers*

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Revealing the subsurface velocity structure beneath the MALK seismic station through teleseismic analysis

P. Thanoja[1], N.G.S.S. Gamage[1*]

[1]*Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

[*]*sng@sjp.ac.lk*

Sri Lanka lies at the center of the northward-moving Indian plate and represents a fragment of East Gondwana. Geologically, the island is composed of four major lithotectonic units characterized by high-grade metamorphic rocks. The present study aims to investigate the subsurface velocity structure beneath the MALK seismic station (GEOFON Station Mahakandarawa, Sri Lanka; 8.4° N, 80.54° E) through teleseismic Receiver Function (RF) analysis. RF analysis has become a widely used technique for studying crustal and mantle structures. Three-component broadband seismic waveform data recorded between 2010 and 2025 were extracted from the GFZ data repository and processed using the ObsPy library. Teleseismic events were selected based on an epicentral distance range of 30° to 90°, body-wave magnitude greater than 5.5 Richters and a signal-to-noise ratio (SNR) above 2.5. RF analysis was employed to isolate receiver-side effects through deconvolution, and forward modeling along with one-dimensional inversion techniques was applied to derive the crustal and upper mantle velocity structure. This analysis revealed a clear Moho discontinuity at a depth of approximately 38 to 40 km. Additional intra-crustal phases suggest the presence of mid-crustal discontinuities or low-velocity zones, while a deeper converted phase indicates a mantle transition zone discontinuity around 420 km depth. The inverted one-dimensional (1D) velocity model indicates a gradual increase in P-wave velocities from 6.01 to 6.62 km/s and S-wave velocities from 3.47 to 3.83 km/s within the upper crust. In the lower crust, the velocities rise to about 7.04 km/s for P-waves and 4.06 km/s for S-waves. Beneath the Moho discontinuity, the upper mantle shows higher velocities, reaching up to 8.18 km/s for P-waves and 4.72 km/s for S-waves.

Keywords: *Seismic inversion techniques, moho discontinuity, receiver function, receiver function, seismic velocity structure, teleseismic events*

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Geological insights into the textural, mechanical and chemical characterization of clay deposits in Gal Oya basin, Sri Lanka

K.L.A.A.R. Liyanage[1*], W.A.G.K. Wickramasinghe[1]
T.B.N.S. Madugalla[1], A.M.N.M. Adikaram[1]

[1]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka*

**ravishaniliyanage@gmail.com*

The clay deposits of the Gal Oya basin in Sri Lanka's dry zone, remain geologically under characterized despite their importance to local industries. This study addresses a significant research gap by investigating the textural, mechanical and chemical properties of these deposits to better understand the environment and processes responsible for their origin. A total of 30 clay samples were collected from sites linked with local clay industries along the Gal Oya river network during the dry season, from February to May. Field observations were followed by laboratory analyses, including grain size analysis through wet sieving and statistical analysis for textural classification, Atterberg limit testing for plasticity and Inductively Coupled Plasma Optical Emission Spectroscopy analysis for chemical composition and possible mineralogy. The clay bodies typically identified as shallow, isolated lenses or layers ranging from 0.5 m to 1.2 m in thickness, inter-bedded with sand and exhibited sticky textures with dark brown to grey colouration. Textural analysis revealed two main groups as silty sand (80%) and sandy silt (20%) indicating a deposition in fluvial dominated, low or mixed energy environments. Atterberg limit tests demonstrated that 80% of clays are high plasticity silts with 15% of low plasticity silts and 5% of high plasticity clays. Chemically, the average iron (Fe) content (4.08 wt.%) is higher than in many other investigated Sri Lankan clays but is comparable to the levels found in typical brick and tile clays. The plasticity and chemical data suggest a mineralogical composition of kaolinite, montmorillonite and illite in Gal Oya basin clays. These results indicate the ex-situ origin of investigated clays in Gal Oya basin, which is needed to be further elucidated by means of trace and isotope geochemical studies of basement rocks.

Keywords: *Alluvial clay, chemistry, plasticity, silts, texture*

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Color and pattern variations of the Sri Lankan Green Pit Viper across three climatic zones of Sri Lanka

D.M.T. Dhananjani[1], A.W.G.C. Dushmantha[2], E.G.D.P. Jayasekara[3], W.A.D. Mahaulpatha[3]*

[1]*Faculty of Graduate Studies, University of Sri Jayewardenepura, Sri Lanka*
[2]*Small Cat Advocacy and Research, Kandy, Sri Lanka*
[3]*Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

**mahaulpatha@sjp.ac.lk*

Snakes exhibit a wide range of color pattern variations, which can be observed within and among populations as well as across different geographic regions. The Sri Lankan green pit viper (*Peltopelor trigonocephalus*) is a mildly venomous snake species endemic to Sri Lanka. This study investigated the color patterns of *P. trigonocephalus* from April 2021 to April 2023. Data on color pattern variations were collected from 68 individuals, including both freshly killed specimens and live snakesThe assessment of color pattern traits was carried out using ranked coding to represent various characteristics. Five traits were examined to characterize color pattern variation, including pigmentation on the supralabial scales, canthal region pigmentation, ventral mottling, the shape of midbody lateral blotches, and the number of blotches along the body. Statistical analysis revealed no significant correlation between pigmentation degree and life stage (adult, subadult, or juvenile), as demonstrated by the Kruskal-Wallis test (DF = 0.4, $P > 0.05$). Additionally, no significant differences in pigmentation were found between males and females, with weak negative correlations observed in the Spearman analysis ($r = -0.098$ for males and $r = -0.133$ for females; both $P > 0.05$). The majority of individuals (89.6%) exhibited dark coloration in the canthal region. This distribution followed a Poisson-like pattern, skewed toward lower color variation. The relationship between blotch number and total length approached significance, indicating a marginal trend ($P = 0.063$). These findings provide baseline insights into the intraspecific color pattern variation of *P. trigonocephalus*, contributing to the understanding of its phenotypic diversity within Sri Lanka. Such pigmentation variation may have ecological and adaptive significance, potentially influencing camouflage efficiency, thermoregulation, or predator avoidance, and thus holds relevance for the species' conservation and management. Future studies incorporating genetic analyses or exploring ecological factors influencing color variation would further clarify the drivers of these patterns.

Keywords: *Life stage, pigmentation, supralabial scales*

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Assessing *Escherichia coli* and total coliform at Arugam bay and Pasikuda beaches: correlations with environmental parameters

J. Sansitha[1*], M.F. Nawas[1]

[1]*Department of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai*

[*]*sansithajalaldeen@gmail.com*

Coastal waters, essential for tourism and recreation, face increasing bacterial contamination risks. This study assessed *Escherichia coli* (*E. coli*) and Total Coliform levels in Arugam Bay and Pasikuda, Sri Lanka, to evaluate potential impacts on public health and coastal water quality. The aim was to enumerate them using two different analytical methods of membrane filter method: The Serial Dilution Method (Method I) and the Direct Sample Method (Method II) and to compare the consistency of their results. Additionally, to examine the correlation between microbial levels and selected environmental parameters, such as temperature, turbidity, electrical conductivity, pH, and dissolved oxygen. Seven samples from each site from two samplings per month were conducted in January and February 2025, and the colony counting and statistical analysis was performed. Method I showed no significant differences ($\alpha = 0.05$) for neither *E. coli* nor Total Coliform levels at either site. However, Method II revealed significant differences over time for both microbial parameters at both sites. Comparison of methods showed no significant differences during January at either site; however, significant differences were observed in February at Arugam Bay only. Spatial analysis under Method I found a significant difference in *E. coli* levels between sites in February, while Method II showed a significant difference in Total Coliforms in January. Environmental correlations were generally weak, though some notable exceptions were observed. These included a strong positive correlation ($R = 0.789$) between pH and Total Coliforms at Arugam Bay (January, Method II), a strong negative correlation ($R = -0.858$ and -0.829) between electrical conductivity and *E.coli* at Pasikuda (January, both methods), and varied correlations between temperature, and electrical conductivity for both microbial parameters at Pasikuda (February). Overall, the study highlights the choice analytical method significantly affects microbial assessment. It emphasizes the need for the appropriate method, standardization and location-specific monitoring strategies to ensure accurate evaluation of microbial water quality in coastal environments.

Keywords: *Bacterial contamination, coastal water quality, environmental parameters, membrane filter method.*

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Assessment of groundwater quality status in Gal Oya river basin, Sri Lanka

P.H.M.S.R. Pahathkumbura[1*], A.M.N.M. Adikaram[1], T.B.N.S. Madugalla[1], D.T. Udagedara[2]

[1]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University, Sammanthurai, Sri Lanka*
[2]*Department of Applied Earth Sciences, Faculty of Applied Sciences, Uva Wellassa University, Sri Lanka*

[*]*shanikaravihari984@gmail.com*

Groundwater is one of the main resources for agricultural, irrigation, and domestic needs in the Sri Lankan dry zone. The Gal Oya River basin is a major intensive agricultural region in the southeastern dry zone of Sri Lanka that has a strong correlation with groundwater. A detailed geochemical analysis of groundwater in this basin has not previously been conducted. Thus, the study aimed to record and analyse the basic groundwater quality parameters in the basin as a preliminary study. A total of fifty groundwater samples were collected from both tube and dug wells across the basin. Measured parameters were pH, electrical conductivity (EC), total dissolved solids (TDS), salinity, major ions (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, HCO_3^{-}, CO_3^{2-}), nutrients (PO_4^{3-}, NO_2^{-}), and heavy metals (Fe, Mn). Analyses were carried out using UV-Vis spectrophotometry, atomic absorption spectrophotometry (AAS), and standard titration methods. The results indicated that the mean values of most parameters (pH 6.57, EC 270.5 µS/cm, TDS 133.0 mg l^{-1}, salinity 0.2 psu, Ca^{2+} 8.5 mg l^{-1}, Mg^{2+} 10.8 mg l^{-1}, Na^{+} 16.7 mg l^{-1}, K^{+} 4.1 mg l^{-1}, Cl^{-} 141.8 mg l^{-1}, SO_4^{2-} 21.5 mg l^{-1}, total alkalinity 52.92 mg l^{-1}, PO_4^{3-} 0.5 mg l^{-1}, NO_2^{-} 0.02 mg l^{-1}, Mn 0.01 mg l^{-1}) were within the acceptable limits set by the Sri Lankan Standards (SLS), except Fe, which averaged 0.6 mg l^{-1}, mainly due to natural geochemical processes in the basement geology of the area. Localised elevations of chloride and phosphate concentrations could be attributed to seawater intrusion, fertiliser runoff, and domestic pollution. The groundwater can be predominantly classified as a calcium–chloride type. In conclusion, while groundwater in the Gal Oya River basin is generally suitable for consumption, the findings highlight the importance of continued monitoring, particularly in vulnerable coastal and farming zones.

Keywords: *Agricultural runoff, geochemical analysis, nutrient pollution, water quality parameters*

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Deforestation and macroeconomic pressures in Sri Lanka: A multi-method analysis

K.M.R.M. Navoda[1*], J.M.M. Udugama[1]

[1]*Wayamba University of Sri Lanka, Makandura, Sri Lanka*

[*]*madushi.m.navoda@gmail.com*

Sri Lanka's continued decline in forest cover has raised concern about the socio-economic drivers of deforestation. While regional and qualitative analyses are common, nationally representative, quantitative studies limited. This study investigates the relationship between forest area (% of land) with GDP growth (%), agricultural land area (%), unemployment rate, and population annual percentage change, using yearly data from 1991 to 2022. A log-log linear regression model was used to estimate elasticities, revealing a strong model fit (R^2 = 0.863; adjusted R^2 = 0.843). Agricultural land area percentage ($\beta = 0.31$, $p < 0.001$) and unemployment rate ($\beta = 0.11$, $p < 0.001$) were significant predictors of forest area (%), while GDP growth (%) and population change (%) were not statistically significant. Non-parametric bootstrap resampling with 1,000 iterations confirmed the robustness and low bias of these estimates. Principal Component Analysis on log-transformed variables identified two rotated components explaining 78% of the total variance. The first component (50%) reflected a trade-off between the percentage of agricultural land (−0.85) and the unemployment rate (0.90). In comparison, the second component (28%) was dominated by GDP growth percentage (0.92), confirming the distinct influence of land use and unemployment conditions. Granger causality analysis revealed that only population change (%) significantly predicted short-term forest area trends ($F = 19.86$, $p < 0.001$), while other variables lacked predictive power at a two-year lag, suggesting delayed or indirect temporal effects. The Augmented Dickey-Fuller test indicated non-stationarity forest area ($p = 0.4308$), suggesting long-term structural drivers, like land-use change. Overall results suggest that deforestation in Sri Lanka is more closely linked to long-term agricultural land use and unemployment conditions than to short-term changes in GDP or population. The study's novelty lies in its multi-method econometric approach. Future research models should integrate drivers, namely illegal logging, infrastructure, governance, and policy changes.

Keywords: *Bootstrap analysis, granger causality, log-log regression, principal component analysis*

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Impacts of Sandcastle Worm (*Phragmatopoma* spp.) proliferation on coral health in the Paraviwella fringing reef ecosystem, Tangalle, Sri Lanka.

P.H.T.M. Herath[1*], C.H.M.D.K. Herath[1], T.R.I. Gamage[1], W.A.A.U. Kumara[1]

[1]*Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Mahawela Road, Tangalle, Sri Lanka.*

[*]*ThiliniFMS2019032@student.ocu.ac.lk*

The Sandcastle Worm (*Phragmatopoma* spp.) lives in a tube-like structure constructed from sand grains. This study reports the first-time record of the occurrence of *Phragmatopoma* spp. (an annelid worm) at Paraviwella inshore reef (PW). This study's primary objective is to investigate the damage caused by the *Pharagmatomopa* spp. on corals by calculating damage of colony area. We selected two coral species, *Pocillopora damicornis* and *Montipora aequituberculata*, which showed the highest percentage coral cover in PW. The study was conducted from October to December 2024. Three random belt transects each with 10 m were deployed parallel to the shore. Using 30 random points along the transect, the nearest coral colony of selected coral species were chosen for collecting the data. The Total Colony area (TC) and the damaged coverage (DC) of each colony were measured by using 0.5×0.5 m^2 and $0.1\times0.1m^2$ grid quadrats. According to the Mann-Whitney Test, the DC between *P. damicornis* and *M. aequituberculata* showed significant statistical difference. The median DC of *P. damicornis* (2.4×10^{-3} m^2) was significantly lower ($P < 0.05$, $N = 30$) than that of *M. aequituberculata* (6.2×10^{-3} m^2). The mean DC (Mean ± SD) of *P. damicornis* and *M. aequituberculata* were $2.6\times10^{-3} \pm 2.5\times10^{-3}$ m^2 and $9.5\times10^{-3} \pm 1\times10^{-2}$ m^2, respectively. Thus, *M. aequituberculata* has statistically higher DC than *P. damicornis*. Variation can be happened due to the growth form and structure of two different coral species, because *M. aequituberculata* has a plate like growth form while *P. damicornis* is a short branching coral. Due to that variation, platelike structure may be provided with a flat and more stable space than the branching type. These interspecific competitions for growth may alter coral diversity in complex ways. Therefore, necessary management strategies, and long-term monitoring are also important to enhance the coral growth and their resilience.

Keywords: *Coral reef, montipora aequituberculata, phramatopoma* spp., *Pocillopora damicorni, sand castle worm*

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Evaluation of pyrene and phenanthrene degradation potential of three different *Trichoderma* species

H.W.L. Fonseka[1], D.A.D.A. Daranagama[1*], R.M.C.S. Ratnayake[1], L.J.S. Undugoda[2]

[1]*Department of Plant and Molecular Biology, Faculty of Science, University of Kelaniya, Sri Lanka*
[2]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka*

[*]*anupamad@kln.ac.lk*

Polycyclic aromatic hydrocarbons (PAHs), including pyrene and phenanthrene, are persistent, toxic, and carcinogenic environmental pollutants. Fungal bioremediation has emerged as a promising, eco-friendly approach for PAH degradation. This study evaluated the micoremediation potential of three *Trichoderma* species*; T. koningiopsis, T. asperellum,* and *T. koningii* isolated from industrial wastewater and sediment in Sapugaskanda in the Gampaha District. Three-day starved fungi in Bacto Bushnell-Haas (BBH) media were inoculated on BBH with 100 ppm of pyrene and phenanthrene separately while fungi without PAHs were prepared as control. After six days at 28 ± 2 °C, diameters of the fungal colonies were measured. 50 mL of BBH broth containing the tested PAHs (100 ppm) as the sole carbon source and supplemented with 500 µL of methylene blue were inoculated with 10 mm fungal disks. Uninoculated flasks served as controls. After incubation (28 ± 2 °C for six days), absorbance was measured at 609 nm using UV-Vis spectrophotometer. In the plate assay, *Trichoderma koningiopsis* exhibited the highest colony diameter on pyrene (84.33 ± 1.26 mm), followed by *T. asperellum* (76.00 ± 1.80 mm), while *T. koningii* showed limited growth (13.67 ± 1.04 mm). On phenanthrene, *T. koningiopsis* again showed the highest growth (58.17 ± 1.61 mm), followed by *T. koningii* (45.50 ± 1.50 mm), with *T. asperellum* showing the lowest (41.17 ± 2.26 mm). UV-spectrophotometric analysis revealed that *Trichoderma koningii* exhibited the highest degradation of pyrene (93.48%) and phenanthrene (93.28%). *T. koningiopsis* degraded 92.38% of pyrene and 92.52% of phenanthrene, while *T. asperellum* showed 92.48% and 91.83% degradation, respectively. These results suggest that *T. koningii* showed a considerably higher potential for degrading the tested PAHs. This study highlights the bioremediation potential of three *Trichoderma* species, indicating their effectiveness as a sustainable approach for detoxifying environments contaminated with pyrene and phenanthrene. Future work needs to assess this in other industrial zones under different seasonal variations to evaluate its wider applicability and efficiency of the remediation approach.

Keywords: *Fungi, hydrocarbons, mycoremediation, pollution, UV-spectrophotometric*

Acknowledgement: This work was supported by the Research Council Grant (RC/SROG/2025/01).

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Acid-modified jack saw dust as a prospective adsorbent for removal of Chromium (III) and Nickel (II)

S.M.T.D. Sathkumara[1], U.K. Jayasundara[1*]

[1]*College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya, Sri Lanka*

* *udaya.jayasundara@maine.edu*

The presence of heavy metals in aquatic environments poses a significant risk to ecosystems and human health. Developing cost-effective, eco-friendly adsorbents is essential for removing trace metals such as nickel and chromium from water to prevent bioaccumulation and ecological harm. This study proposes that acid-modified jackfruit sawdust can act as a cost-effective and sustainable adsorbent for the removal of Cr(III) and Ni(II) ions from water. Utilizing this abundant agricultural by-product from Sri Lanka enhances sustainability by adding value to locally available waste materials. Cr (III) and Ni (II) pose ecological and human health risks at high concentrations in water and soil, necessitating their removal to comply with environmental standards and protect aquatic life and public health. The sawdust was treated with 25 mL of 0.75 M hydrochloric acid (HCl) and shaken at 160 rpm for 4 hours, then left overnight, which significantly enhanced its adsorption capacity from 1.108 mg/g to 2.521 mg/g. The treated samples were thoroughly washed with DI water and oven-dried at 80 °C for 3 hours before adsorption experiments. The highest uptake of both metal ions was recorded using this concentration The acid-modified saw dust's point of zero charges (PZC) was found using the salt addition approach. The point of zero charge of the acid-treated sawdust was found to be 5.52, suggesting effective interaction with metal ions at slightly acidic to neutral pH. Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) were utilized to analyze the adsorbent's surface characteristics and morphological changes after metal adsorption, revealing functional group participation and increased surface roughness and pore development post-treatment. Kinetic studies applied pseudo-first-order and pseudo-second-order models to the data. The adsorption of Cr (III) and Ni (II) onto acid-modified jackfruit sawdust follows a pseudo-second-order kinetic model, as the plot of (t/q_t) versus (t) is linear with high correlation coefficients (Cr (III): (R^2 = 0.99751), Ni (II): (R^2 = 0.99376)), indicating that the model accurately describes the adsorption kinetics. These results highlight acid-modified jack sawdust as an affordable and sustainable option for remediating heavy metal-contaminated water. Future studies will explore field applications, cost-effectiveness, and the regeneration of this adsorbent for sustainable water treatment.

Keywords: *Adsorption, FTIR, heavy metals, kinetics, SEM*

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Preliminary insights into *Apogonia* Beetle outbreak prediction in Sri Lanka: A case study in a cashew plantation at Wanathavilluwa, Puttalam

W.M.H.U. Wijeratne[1], S.L. Ranasinghe[1*], U.C.K. Fernando[2], N. Athukorala[1], S.P. Benjamin[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2] *Sri Lanka Cashew Corporation, Colombo, Sri Lanka*

**sasanka.zfmk@gmail.com*

Beetles occur frequently in crop cultivations, highlighting their significant ecological role in the agricultural landscapes. Although certain beetle genera are documented, the gaps in knowledge regarding their status as economic pests and the patterns of their sporadic population increases remain significant. This is critical, as some species have reached outbreak levels globally in recent decades. Therefore, field-based investigations remain a key approach to pest monitoring and control planning. This case study focuses on a sudden increase in beetle populations reported from Wanathavilluwa in the Puttalam District, one of Sri Lanka's major cashew cultivation areas. The damage, observed mainly on cashew leaves, was characterized by edge feeding that resulted in round-shaped margins, indicating the possible emergence of a beetle pest. Therefore, a preliminary field survey was carried out in the affected area to identify the beetle species and to document their abundance. Sampling of adult beetles was carried out in two different sites in the cashew plantation, Wanathawilluwa in December 2023. Beetles were captured using two UV-light traps from 18:00 to 07:00 h. Approximately 500 adult beetle specimens were examined and identified three types of *Apogonia* sp. (n= 437), and a few *Sophrops* sp (n= 27) and Sericini chafers (n= 23) (*Maladera mollis*, *M. pubescens*). The *Apogonia* population showed a female biased sex ratio (68.8%). The most abundant beetle (88.7%), tentatively identified as *Apogonia rauca*, has been previously reported from several locations, with higher abundances in dry zones like Dambulla. This pattern may suggest a preference for warmer environments, where rising temperatures could facilitate future population increases, possibly leading to outbreak scenarios. Although the current population increase did not significantly impact cashew yield during the study year, these findings highlight the need for continuous monitoring and further ecological research to inform sustainable, environmentally friendly pest management approaches in agroecosystems.

Keywords: *Agroecosystem, coleoptera, pest, phytophagous*

Acknowledgement: Cashew plantation division, Wanathavilluwa, Puttalam

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A choice-based analysis of farmers' preferences for wildlife damage mitigation in Mahawilachchiya and Dimbulagala divisional secretariats in the North Central Province

W.M.C.S. Senevirathne[1], J.M.M. Udugam[1*]

[1]*Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka*

[*]*menukaudugama@gmail.com*

In Sri Lanka, human-wildlife conflict (HWC) is becoming a severe problem for the farmers and wildlife conservation. In the North Central Province, a hotspot for HWC, this study aims to assess the socioeconomic effects and farmer preferences regarding HWC mitigation strategies. A semi-structured questionnaire was used to collect data from 310 farmer households in the North Central Province. The results show that 88.3% of respondents had experienced HWC. Crop damage, grain loss, livestock damage, property loss, mitigation costs, and costs related to human injury and fatalities, as estimated by the Value of Statistical Life (VSL), were all included in the total economic loss, which was determined by adding up the direct and indirect costs. A Choice Experiment (CE) was carried out, and the Conditional Logit (CL) model was used to analyze farmers' willingness to implement HWC mitigation strategies. Human fatalities accounted for more than 75% of the season's average total cost of Rs. 478,069 per household. The choice experiment's findings show that compensation-based measures are strongly preferred, especially when there have been significant impacts. A 25% relief for crop loss (Rs. 798.35, Standard Error (SE) = 1.375) and an additional 75% compensation for death or injury (Rs. 933.37, SE = 1.737) showed the highest marginal willingness to pay (MWTP). On the other hand, shared patrolling strategies, which involve 50% community participation and 50% government, were negatively valued (MWTP = Rs. -160.09, SE = 0.415), indicating a lack of community support for collective mitigation. Farmers prefer to financially support equitable and well-targeted mitigation programs, as evidenced by the total MWTP of Rs. 1,989 per household per month. In order to foster long-term human–wildlife coexistence, these findings highlight the significance of HWC mitigation programs that prioritize appropriate compensation and are customized to community preferences, especially in areas with high levels of conflict.

Keywords: *Choice experiment, conditional logit, economic loss, farmer household, willingness to pay*

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Assessing microplastic pollution in agroecosystems: distribution patterns, material characterization, and ecological risk perspectives

I.P. Edirisingha[1,5], L.J.S. Undugoda[1*], P.M. Manage[2], N. Lankasena[3], C. Patabendige[4], R.N. Nugara[1], P.I. Macreadie[6], P. Bhadury[7]

[1]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka*
[2] *Center for water quality and algae research, Faculty of Applied sciences, University of Sri Jayewardenepura, Sri Lanka*
[3]*Department of Information and Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka*
[4]*Department of Science for Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka*
[5] *Faculty of Graduate Studies, University of Sri Jayewardenepura, Sri Lanka*
[6] *Centre for Nature Positive Solutions, Biology Department, School of Science, RMIT University, Melbourne, VIC 3000, Australia*
[7] *Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata, India*
* *lankaundugoda@sjp.ac.lk*

Microplastics in agroecosystems have drawn notable global attention as an emerging pollutant in recent years. This study aims to assess, for the first time, the occurrence and spatial distribution of microplastics in soils within the agroecosystems of the Kalpitiya region which is recognized as a major vegetable cultivation area. Soil samples were collected in triplicate from four leafy vegetable plots in Kalpitiya. Microplastics were then extracted through the subsequent density separation, followed by peroxide oxidation to remove organic matter. The recovered microplastics were analyzed using a stereomicroscope and Raman spectroscopy. The analysis characterized and quantified their color, particle size, abundance, and morphological type. Results showed an average microplastics abundance of 2.076 ± 0.561 particles g^{-1}, with a maximum of 3.32 particles g^{-1}. Particle sizes ranged from 0.4 µm to 774 µm, with smaller fractions predominating. Color distribution was dominated by blue (42%), black (29%), and green (16%) microplastics. Morphologically, fragments accounted for 60 % of particles, while fibers and films each represented 12 %. A subset of particles from each morphological category was randomly selected and transferred onto glass fiber filter paper (0.47 µm) for characterization by Raman spectroscopy. The Raman spectrum depicted the predominant polymers in the selected plots to be polyethylene terephthalate (PET), polystyrene (PS) and Ethylene Vinyl Acetate (EVA) based on their major peaks at 1528 cm^{-1}, 1000 $cm^{-1,}$ and 1450 cm^{-1}, respectively. It was revealed that 50% of the tested particles were PS, and 12.5% were PET and EVA. These findings suggest that the proximity to roads and the sea may influence variation in MP loads. Overall, the study provides valuable insights into microplastic contamination and potential pollution sources in Sri Lankan agroecosystems. The outcomes underscore the urgent need to address microplastic pollution in Sri Lanka's agricultural environments to protect ecosystems and prevent further accumulation and uptake in food crops.

Keywords: *Kalpitiya, Raman spectrophotometry, soil contamination, unmanaged wastes*

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Comparative analysis of taxonomic and functional diversity in habitat-driven beetle assemblages of tropical lowland and submontane Forests

W.M.H.U. Wijeratne[1], M.S.Z. Ameena[1], S.L. Ranasinghe[1*], S.P. Benjamin[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*sasanka.zfmk@gmail.com*

Beetles are one of the most diverse insect groups and play vital ecological roles in nutrient cycling, decomposition, and predation. However, their responses to habitat variation in tropical forests remain poorly understood. This study examined beetle family richness, abundance, and functional composition across three habitat types; central forest (CF), forest edge (FE), and grassland (GR) within two Sri Lankan Forest landscapes: Hiyare (lowland rainforest) and Riverston (submontane forest). We selected Hiyare and Riverston as elevational end-members that share CF, FE, GR habitats to assess whether habitat effects generalize across contrasting forests. Field surveys were conducted in 2019 and 2020 (Feb–Mar/Oct–Nov and Jun–Jul/Nov–Dec, respectively) using UV light traps (72 events total: 25, 25, and 22 in CF, FE, and GR), yielding >10,000 beetles. Species accumulation curves approached asymptotes at both localities, indicating adequate sampling. Assemblages were analyzed across habitat types for taxonomic and functional patterns. Forest edges consistently supported the highest beetle abundance and family richness in both forests: 77.3% of individuals and 37 families in Hiyare, and 44.5% and 58 families in Riverston. Grasslands at both sites exhibited the highest taxonomic evenness. Beta diversity analysis revealed significant taxonomic differences among habitats in Hiyare but not in Riverston ($p = 0.026$ and $p > 0.6$); NMDS plots supported this greater habitat separation in Hiyare. Functional trait analysis showed clear habitat specific patterns; predators dominated FE, xylophagous beetles were common in CF, and herbivores prevailed in GR. Functional richness and divergence were highest in CF and FE (1.44), with evenness highest in GR (0.89). While both forests showed trends toward distinct functional assemblages, only Riverston exhibited statistically significant functional divergence (Kruskal–Wallis, $p = 0.018$), indicating broader trait variation. These contrasting patterns highlight the importance of integrating both taxonomic and functional perspectives to better understand habitat-driven biodiversity in tropical forests. The study also emphasizes the ecological importance of forest edges and structurally diverse habitats in conserving beetle diversity and supporting ecosystem functioning.

Keywords: *Conservation, diversity patterns, ecological functions, forest edge*

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Assessing microplastic distribution in an urban Lake: A study of Kurunegala lake's water and sediment

K.U.A.C. Kiriwaththuduwa[1]*, K.P.M. Suchinthana[2], H.L.K. Sanjaya[1], T.P.D. Gamage[1]

[1]*Department of Limnology & Water Technology, Faculty of Fisheries & Marine Sciences and Technology, University of Ruhuna*
[2]*Department of Fisheries and Aquaculture, Faculty of Fisheries & Marine Sciences and Technology, University of Ruhuna*

**K5682.avishka@gmail.com*

Plastic particles less than 5mm are called microplastics (MPs). MPs are environmental pollutants that spread in both marine and freshwater ecosystems. Additionally, Kurunegala lake is an urban lake located near to Kurunegala town Sri Lanka, which was used by Water Supply and Drainage Board as the drinking water source for the Kurunegala urban area. This study was conducted to determine the abundance of MPs in Water and Sediment in Kurunegala lake. ISO/DIS 5667-27 recommendation was followed to determine the sampling sites base on that samples were collected from eight locations and recommended H_2O_2 digestion protocols was followed to digest the organic materials then samples filtered through 0.1 µm filter papers. Visual observation was used to quantify the MPs followed by the FTIR analysis to confirm the polymer type. MP content in sediment was significantly higher than water in all sites. Water (13.53±0.86 MPs/L) and sediment (111.00±3.24 MPs/kg) collected from site 06 contained significantly higher MP content than other sites. Fragments were the most prevalent MP type, with the highest abundance found in Site 07s water (11.73 ± 4.07 MPs/L) and sediments (56.00 ± 3.22 MPs/Kg). MPs were classified to three size classes as large (>750 µm), medium (250-750 µm) and small (< 250 µm) and small MPs were significantly high in all samples. Blue was the Predominant color followed by black, red and green in majority of samples. Due to small size of the MP particles FTIR test identified only polypropylene with sufficient accuracy. Results suggest both water and sediment are polluted by MPs and new studies and advanced technologies are necessary to assess the baseline data from the present study by revealing the possible pathways, sources, and impacts of MPs within water and sediment samples of Kurunegala lake.

Keywords: *Drinking water, FTIR, Kurunegala lake, microplastics, sediment*

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Sustainable tourism potential in Maragala mountain range, Sri Lanka using GIS based suitability analysis

S.A. Sudusinghe[1*], G. Naveendrakumar[1], S.A. Sudusinghe[2], D.M.P.T. Dissanayaka[3]

[1]*Department of Bio-Science, Faculty of Applied Science, University of Vavuniya, Sri Lanka*
[2]*Divisional Secretariate, Buttala, Sri Lanka*
[3]*Central Environmental Authority, Monaragala District office, Sri Lanka*

**anjaleesudusinghe1999@gmail.com*

The need for sustainable approaches in tourism will support as a decisive tool in environmental evaluation and planning. Maragala Mountain range which is highest isolated mountain range in Sri Lanka, is a high- ecological environment, located in the Monaragala District of the Uva province, Sri Lanka. The geographic information systems (GIS) and Multi Criteria Decision Model which provides an effective tool for evaluating the environmental, social and infrastructural variables was used to identify nature conservation, influence of tourism development and development priorities among the Maragala Mountain Range. Integration of spatial data and the creation of suitability models, offered decisive insights into areas that are most appropriate for tourism development. This study defined the most suitable camping sites, nature trails and the mapped tourism attraction points in the Maragala Mountain range. Through the application of Analytical Hierarchy Process (AHP) and weighted overlay techniques, the research systematically evaluates the trade-offs between tourism potential and conservation priorities, producing suitability maps that categorize the mountain range into zones of varying tourism development appropriateness. The findings reveal distinct spatial patterns of tourism suitability across the Maragala range, identifying areas where controlled tourism activities can be sustainably introduced without compromising environmental stability, as well as highly sensitive zones requiring strict protection.

Keywords: *Biodiversity, isolated mountain, multi criteria decision model, suitability models*

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Effectiveness of fruit-based baits as attractants for attracting nocturnal lepidopterans: A case study based on two locations

A.A. Jayasekara[1*], K.S. Hemachandra[1], U.G.A.I. Sirisena[2], V.A.T. Prabashwara[3]

[1]*Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[3]*Dilmah One Earth Climate Change Centre, Nawalapitiya, Sri Lanka*

**arundij@agri.pdn.ac.lk*

Fruit-based alcoholic baits are known to attract some moths. The attraction of different lepidopterans to such baits is important for integrating baits into diversity assessments. Conventional light traps arguably fail to attract frugivorous moths causing their under-representation in diversity assessments. Unlike pollinating moths, frugivorous moths feed on fruits, affecting yield and quality. *Embul kesel* (*Musa* sp.), *Nas naran* (*Citrus japonica* Thunb.), and jackfruit (*Artocarpus heterophyllus*) were mixed separately with fermented coconut water (alcohol source) and brown sugar (sweetener). Three pieces of equal sized white cotton cloths were soaked separately with the different baits and hung in three locations at least 20m apart at the two experimental sites (Mahailuppallama Sub Campus- 11th-15thFebruary and Dilmah One Earth Climate Change Centre, Nawalapitiya- 2nd-7th March). The bait traps were rotated to eliminate site-specific biases. The light tent and the bait traps were observed hourly from 07:00 PM to 12:00 AM during six consecutive nights at each site. Only 12.10% of the Mahailuppallama sample (15/124 moths) responded to the three baits, representing just 3/13 identified families; namely Erebidae (73.33%), Crambidae (20%), and Tortricidae (6.67%). The percentage of Nawalapitiya moths attracted to the baits was 7.56% (17/225), representing 5/19 families: Erebidae (29.41%), Crambidae (11.76%), Gelechoidae (11.76%), Noctuidae (11.76%), Tortricidae (35.29%). Frugivory being limited to certain species and the absence of fruiting trees during the sampling period, explains the lower moth relative to the light tent at both sites. No selective preference was observed at $P>0.05$ in a log linear analysis of the moth count detected at each bait. Conclusively, baits can be recommended for supplementary use with light tents; the majority of the moths discovered from the baits were not detectable from the light trap and vice versa. The use of baits in orchards would enable selective destruction of the target pests, preventing pesticide overuse.

Keywords: *Biodiversity, camouflage, frugivory, pest monitoring, selective preference*

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Spatial changes in seagrass habitat in response to shrimp farming expansion in Puttalam Lagoon, Sri Lanka

M.M.S. Sara[1], G. Naveendrakumar[1*]

[1]*University of Vavuniya, Vavuniya, Sri Lanka*

**gnaveendra@vau.ac.lk*

Seagrass ecosystems are essential for coastal biodiversity, sediment stabilization, and other vulnerable ecosystem functionalities. However, the expansion of shrimp farming has posed increasing threats to these habitats at least in Puttalam Lagoon in Sri Lanka. This study investigates the spatial dynamics of seagrass cover in response to shrimp farming activities over a ten-year period from 2013 to 2023 using remote sensing and GIS-based techniques. Five sub-zonation as defined in the IUCN GIS Atlas, used in this study. Satellite imagery from Google Earth Pro was analysed using ArcGIS 10.8, where seagrass beds and shrimp farms were manually digitized. Contrast enhancement and vegetation indices were applied to improve seagrass detection. Change detection analysis was performed to quantify variations in seagrass extent, and buffer analysis (100 m and 200 m) was used to examine proximity impacts from shrimp farms. Results indicate notable seagrass decline in areas close to aquaculture, with the Kalpitiya–Kuringipitiya zone showing a 22% reduction in seagrass cover and a 7% decrease in shrimp farming area between 2013 and 2023. These findings suggest dynamic shifts in land use and underline the need for more sustainable aquaculture development. The study contributes to the understanding of anthropogenic impacts on sensitive lagoon ecosystems and supports evidence-based conservation and planning.

Keywords: *Aquaculture impacts, buffer analysis, GIS mapping, habitat loss, remote sensing*

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Integrated resistivity and magnetic survey for subsurface dyke geometry, Wahawa, Sri Lanka

B.G.H.D. Karunarathna[1*], M.P. Thilakarathne[2], A.M.N.M. Adikarm[1,2], N.D. Subasinghe[2]

[1]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University, Sri Lanka*
[2]*National Institute of Fundamental Studies, Hanthana Road, Kandy*

[*]*hasithad895@gmail.com*

Present study utilizes integrated resistivity and magnetic surveys to investigate the subsurface dolerite dyke at Wahawa, Sri Lanka aiming to characterize its geometry and structural relationships with respect to the country rock. Mini Sting resistivity meter was used in 2D profiling with Schumberger array. AGI Earthimager software was applied for that data interpretations. GSM-19v Overhauser magnetometer was used in the identification of magnetic variations along the desired survey lines that are parallel and perpendicular. Variations of the corrected magnetic flux were clearly visible across the boundaries of the dyke which dropped the values compared to the besides' rocks identifying as hornblende biotite migmatite and granitic gneiss. The negative anomaly of the dolerites may be due to the lower susceptibility of the minerals, fine grained texture, high fracture intensity or indicating the reverse magnetism during its formation period. Though hornblend biotite migmatites show positive anomaly, granitic gneiss indicates lower negative anomaly may be representing its lower susceptibility. Average width of the dyke is about 40-50 m bearing sharp contacts in boundaries. Resistivity surveys confirm the average width which shows high resistivity values for dolerites along the survey line with compared to the surrounding rocks. 2D image of the resistivity results indicate the vertical extensions of the dyke are more than the maximum reachable levels (40 m) of the present investigation. Deep fractures are noted in hornblend biotite migmatite rock which is positioned in the west direction of the northwest-southeast extending dyke. Further sounding surveys are recommending concerning the cross cutting fracture depths to recognize the pressure head controlling deep ground water flow conditions from the central highlands. This will help in diagnosing a relationship for the strengthen of the water temperature in hot springs in eastern part of the dyke in the absence of deep ground water dilutions.

Keywords: *Dolerite dyke, magnetic anomalies, resistivity survey, Wahawa*

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Petrogenetic significance of Cordierite in the southwestern and central highland complex, Sri Lanka

K.H. Senevirathne[1], P.L. Dharmapriya[1]*, S.P.K. Malaviarachchi[1], G. Wickramasinghe[2], N.D. Subasinghe[3]

[1]*Department of Geology, Faculty of Science, University of Peradeniya, Sri Lanka*
[2]*Faculty of Applied Sciences, Oluvil University, Sri Lanka*
[3]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*prasannad@sci.pdn.ac.lk*

Sri Lanka is a high-grade metamorphic fragment of central Gondwana comprising four geological complexes: the Highland (HC), Wanni (WC), Kadugannawa, and Vijayan. Peak conditions in the south-western Highland Complex (SWHC) were ~5–7 kbar at 800–900 °C, whereas the central, southern, and eastern HC reached ~8–10 kbar at 800–950 °C. Following peak metamorphism, HC granulites underwent near-isobaric cooling (IBC) and near-isothermal decompression (ITD). Cordierite-bearing gneisses occur in the SWHC and southern WC near the HC–WC boundary but are scarce in the central HC, where their significance remains uncertain. Cordierite stability reflects bulk composition, temperature, pressure, and fluid activities. To investigate cordierite abundance in the SWHC versus central HC, we sampled the SWHC (Horana, Ingiriya, Homagama, Meegoda) and central Sri Lanka (Kotmale, Gampola, Ramboda). Petrography constrained mineralogy and microtextures, and Electron Probe Microanalysis (EPMA) determined mineral chemistry. In the SWHC, cordierite occurs in prograde, peak, and retrograde assemblages; melt patches indicate syn-migmatitic growth. In the central HC, cordierite is typically restricted to decompression reaction textures and melt patches. At Gampola and Kotmale, cordierite forms orthopyroxene–cordierite symplectites after garnet and as a breakdown product after orthopyroxene–sillimanite–quartz. At Ramboda, garnet-hosted melt inclusions contain cordierite, biotite, and quartz, although cordierite is absent from the matrix. In SWHC samples, cordierite is present in the matrix and melt patches, and at Ingiriya and Meegoda, cordierite–spinel motes replace garnet. EPMA indicates X_{Mg} of 0.88–0.99 at Gampola and Kotmale, ~0.76–0.77 at Ingiriya, and ~0.84–0.86 in Ramboda melt inclusions. Cordierite in peak/retrograde assemblages and melt patches in the SWHC reflects high-*T*, low-to-medium-*P* metamorphism with partial melting, followed by retrograde cooling and decompression. Conversely, its absence from peak assemblages in the central HC implies high-*T* and relatively higher-*P* metamorphism, with later retrograde cooling and ITD-related decompression permitting limited retrograde cordierite growth. Targeted thermobarometry and geochronology will refine these interpretations.

Keywords: *Cordierite-bearing gneisses, highland complex, pressure-temperature-time (P–T–t) evolution, partial melting (anatexis)*

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Voices from the shore: public views on coastal plastic pollution in Galle and Matara districts, Sri Lanka

K.P.M. Suchinthana[1], S.S.T. Hewage*[1], D.P.P. Sandaruwan[1], K.M.A. Dissanayaka[1]

[1]*Faculty of Fisheries & Marine Sciences and Technology, University of Ruhuna, Matara, Sri Lanka*

[*]*sayuriassathsarani@gmail.com*

Plastic pollution is a major issue affecting the quality of the coastal recreational experience. This study investigates personal plastic consumption and awareness of coastal plastic pollution through a public survey conducted in the Galle and Matara districts of Sri Lanka. We hypothesized that high plastic pollution in beach areas is associated with limited awareness and inadequate waste management infrastructure. Data were collected through a structured questionnaire (211 participants) from April to June 2024 at selected beaches: Galle Fort, Dewata, Unawatuna, Matara, Polhena, Dondra, and Eliyakanda. Survey data were analyzed using descriptive statistics to identify relationships between awareness, behavior, and demographic factors. Results revealed that all participants (100%) used plastic products, with polythene bags (44.48%) and plastic bottles (40.79%) being most common. Easy availability (40.71%) and low cost (28.14%) were the main reasons for use. Most respondents (39.93%) burned their plastic waste, while only 2.2% practiced recycling. The majority (96%) believed plastics harm marine organisms, and 53.55% perceived beaches as dirty, with plastics as the most prominent waste type (49.41%). Plastic bottles (37.07%), polythene bags (29.15%), food and beverage packages (15.64%), and straws (8.11%) were identified as the main pollutants. Less than half (41.23%) felt plastic pollution completely ruins the beach experience. Regarding waste management, 59.42% carried their plastic waste home, and 73% reported inadequate waste bins. About 59% believed individuals bear more responsibility than government, while only 15% voluntarily clean beaches. Many respondents (28.2%) suggested reducing personal plastic use as the best mitigation measure, followed by more waste bins (26.48%) and penalties (17.16%). This study highlights the urgent need to enhance public awareness and collaborative action. Findings emphasize policy interventions such as restricting single-use plastics, improving beach waste facilities, and implementing public education campaigns. Future studies should test pilot awareness programs and conduct regional comparisons to guide sustainable coastal management.

Keywords: *Plastic pollution, reduce consumption, southern coast, waste management*

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Pathogen diversity and host susceptibility to stem canker in urban forest trees of Sri Lanka

P.K. Ranasinghaarachchi[1], A.H. Ekanayaka[2*]

[1]*Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*
[2]*Department of Urban Bioresources, Faculty of Urban and Aquatic Bioresources, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

**anushahasini@sjp.ac.lk*

Urban forests are vital for ecological stability, but diseases like stem canker threaten the health and structural integrity of trees. This study evaluates the impact of stem canker on the health and composition of urban forest patches at the University of Sri Jayewardenepura, with the aim of supporting sustainable urban forestry management in Sri Lanka's first carbon-zero-certified university. Eleven patches (2.6092×10^4 m²) were mapped using QGIS 3.28 software and AutoCAD, with a survey of 262 trees belonging to 13 families, with a mean temperature of 25–30 °C. Diameter at breast height (DBH) (0.37–3.05 m) and lesion area (2.75×10^{-3}–3.5721 m²) were measured, with stem canker affecting 50 trees (19.08% incidence, range: 3.85–50%). Infected tissues were cultured on potato dextrose agar. Morphological analysis identified *Lasiodiplodia* spp., *Nectria* spp., and *Hypoxylon* spp. as the predominant genera (Ascomycota), confirmed via Koch's postulates. Fabaceae (32%, *Cassia* sp., *Delonix* sp.) was the most affected family, followed by Anacardiaceae (20%, *Mangifera* sp.) and Combretaceae (14%, *Terminalia* sp.), aligning with global literature citing Fabaceae's high canker susceptibility. In contrast, Moraceae, Meliaceae, and Sapotaceae exhibited lower infection rates (4–6%), indicating potential resistance. Weak correlation between tree size and lesion area ($R^2 = 0.184$) suggested DBH is not a reliable predictor of infection severity, possibly due to microclimatic or species-specific responses. Comparative family-level graphical analysis supported this. High-biodiversity patches (with eight families) showed lower infection rates (26.83%), supporting the dilution effect. These findings provide a foundation for integrating resistant species and biodiversity-driven strategies into reforestation efforts. They also offer valuable insights for future work on molecular pathogen identification and host–environment interactions. This knowledge can be applied to enhance climate mitigation and carbon sequestration through informed urban forest planning in tropical environments.

Keywords: *Biodiversity, disease susceptibility, pathogenic fungi, tree health, tropical forest management*

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Assessment of background radiation levels in collegiate science classes: a case study, Kandy, Sri Lanka

A.M.N.M. Adikaram[1,2], M.P. Thilakarathna[1], N.D. Subasinghe[1*]

[1]*National Institute of Fundamental Studies, Hanthana Road, Kandy*
[2]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University, Sri Lanka*

**deepal.su@nifs.ac.lk*

Background radiation is an integral part of the natural environment, existing in both ionizing and non-ionizing forms, which can originate from natural or man-made processes. The levels of background radiation vary spatially and temporally, necessitating monitoring to enhance societal safety as few negative case studies recorded. This study assessed the levels of ionizing and non-ionizing background radiation in a school in Kandy, which offers collegiate science classes with scientific laboratories. The data will record as a base value for the collegiate science classes. A preliminary measurement was conducted on September 24, 2024, covering the school's science classes (9) and laboratories (3), with an outside location as a reference. Selected bands of the radio spectrum were measured using a spectrum analyzer, a Geiger counter was utilized to gauge ionizing radiation levels, adhering to standard measurement protocols. The background radiation levels for ionizing radiation ranged from 0.01 mR/hr (0.878 mS/yr) to 0.02 mR/hr (1.752 mS/yr) across the measured locations, including laboratories and classrooms for science students. These levels are below the global average ionizing radiation exposure of 2.4 mS/yr, as reported by the International Commission on Radiological Protection (ICRP), which accounts for natural radiation from terrestrial sources and cosmic rays. Furthermore, the measured maximum radio frequency bandwidths for Industrial, Scientific and Medical applications (ISM), Global System for Mobile communication (GSM 900, GSM 1800), Wireless Local Area Network for Wi-Fi facilities (WLAN), and Long Term Evolution network for 4G and 5G (LTE 26) were 0.000004, 0.00763, 0.00152, 0.000241, and 0.000304 μW/cm², respectively. These values are significantly below the national standard of 10 μW/cm² established by the Telecommunications Regulatory Commission, following the guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Therefore, the results indicate no hazardous levels of background radiation in the school's science environments, which include physics, chemistry, and biology laboratories.

Keywords: *Geiger counter, spectrum analyser, radiation measurements, Kandy*

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Quantification and characterization of crude polysaccharides extracted from selected seaweed species in Sri Lanka

H.S.A. Perera[1], K.K.A. Sanjeewa[2], I.U. Kariyawasam[1*]

[1]*Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Homagama, Sri Lanka*

**isurufasi@sjp.ac.lk*

Seaweeds, or marine macroalgae, can have a significant impact on the economy and livelihood in Sri Lanka. The primary focus of this study is to characterize and quantify crude polysaccharides in three different seaweed species in Sri Lanka. *Ulva fasciata* Delile from green algae, *Gracilaria hikkaduwensis* Durairatnam from red algae, and *Sargassum aquifolium* (Turner) C. Agardh from brown algae collected from the Thalpe coastal area, were subjected to the extraction of crude polysaccharides to proceed with the study. After extracting crude polysaccharides using hot water, Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR) was used to characterize the chemical composition of the extracted crude polysaccharides. The moisture content of fresh seaweeds, total polysaccharides content, and total polyphenol content of crude polysaccharides were carried out for quantification assays using the loss-on-drying method, the phenol-sulfuric method and the Folin–Ciocalteu method, respectively. In ATR-FTIR characterization, the characteristic peaks that account for the functional chemical groups and bonds in polysaccharides were obtained for all three seaweed species. The fresh sample of *G. hikkaduwensis* had the highest moisture content, and its crude polysaccharide fraction had a significantly higher total polysaccharide content. The lowest values for both the moisture content assay and total polysaccharide assay were obtained by *S. aquifolium*. In contrast to that, in the total polyphenol assay, *S. aquifolium* had a substantially higher polyphenol content, while *G. hikkaduwensis* recorded the lowest values of polyphenols in the assay. The green alga, *U. fasciata,* recorded the quantified values between the values of *G. hikkaduwensis* and *S. aquifolium* in all quantification assays. This preliminary study provides the groundwork for baseline information on seaweed crude polysaccharides, and future work on these polysaccharides is required to confirm the usability of these species in various industrial applications.

Keywords: *Atr-ftir, macroalgae, moisture, phycocolloids, polyphenol*

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Occurrence and compositional characteristics of microplastics in the lagoonal environments of the southeast coast, Sri Lanka

A.G.M.I. Rajawardhana[1], M.N.M. Farhath[2], T.B.N.S. Madugalla[3*]

[1]*Department of Physical Science, Faculty of Applied Science, South Eastern University, Sammanthurai 32200, Sri Lanka*
[2]*Department of Chemical Science, Faculty of Applied Science, South Eastern University, Sammanthurai 32200, Sri Lanka*
[3]*Earth Science Unit, Department of Physical Science, Faculty of Applied Science, South Eastern University, Sammanthurai 32200, Sri Lanka*

**nadeeshamadugalla@seu.ac.lk*

Microplastics (MPs), defined as plastic particles less than 5 mm in size, have emerged as widespread and persistent aquatic pollutants due to their non-biodegradable nature and potential bioaccumulation. This study investigates the mode of occurrence, spatial distribution, compositional characteristics, weathering features, and possible sources of MPs in the selected lagoonal environments along the southeast coast of Sri Lanka from Kalmunai to Thirukkovil. A total of 40 samples, comprising 18 sediment and 22 water samples, were collected across multiple coastal lagoonal sites. The MPs were extracted using a density separation method with NaCl solution (1.20 g/mL) and characterized by visual analyses under a petrographic microscope and chemical identification through Fourier Transform Infrared Spectroscopy (FTIR). The results revealed five main types of MP forms as fragments, films, fibers, foams, and unknown irregulars, with white/transparent and blue being the most common colors. The sediment collected from lagoons was mainly composed of fragments (41.01%) and films (30.41%), whereas the water samples contained predominantly films (36.32%) and fibers (31.58%). The FTIR analyses identified polyethylene (PE) and polystyrene (PS) as the most common polymers, likely derived from domestic packaging and fishing-related debris. Surface morphology showed evidence of weathering, with discoloration likely caused by photo-oxidation by ultraviolet (UV) radiation. The highest MP concentrations were found near urban runoff zones and river mouths, especially in the Sainthamaruthu and Nintavur lagoons. This research emphasizes the urgent need for integrated waste management plans and continued monitoring to understand the fate and transport of MPs in sensitive lagoon ecosystems.

Keywords: *FTIR, lagoons, microplastics, pollution, Southeastern coast*

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Spatiotemporal patterns of electrocution-induced elephant deaths in Sri Lanka

D.K. Rathnayake[1], S. Weerakkody [2,3], E.P. Kudavidanage[1,4*]

[1]*Department of Natural Resources, Sabaragamuwa University of Sri Lanka*
[2]*Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences & Center for Integrative Conservation, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences*
[3]*Yunnan International Joint Laboratory of Southeast Asia Biodiversity Conservation & Yunnan Key Laboratory for Conservation of Tropical Rainforests and Asian Elephants*
[4]*Tropical Ecosystem Research Network (TERN)*

**enokakudavidanage@gmail.com*

Electric fencing is one of the popular mitigation methods used in Human-Elephant Conflict (HEC) mitigation worldwide. In Sri Lanka, both government (installed by the Department of Wildlife Conservation (DWC)) and privately owned electric fences are used. In recent years, electrocution has become one of the growing causes of human-induced elephant deaths in Sri Lanka. Therefore, this study aimed to examine the spatiotemporal distribution of electrocution-induced elephant fatalities in Sri Lanka from 2010 to 2024. The reports of elephant deaths were extracted from the DWC database, and a trend analysis was conducted using RStudio software to identify the temporal patterns of electrocution-induced elephant deaths. Geographic Information System (GIS) techniques were used to map and analyse spatial patterns, highlighting high-risk areas for electrocutions in Sri Lanka. Kernel Density Estimation (KDE) maps were created using QGIS software for this purpose. A total of 521 electrocution-induced elephant deaths were recorded during the time period, accounting for 21% of the human-induced elephant deaths. The trend analysis showed a significant increase in electrocution-induced elephant deaths from 12.16% of total human-induced elephant deaths in 2010 to 25.57% in 2024. Anuradhapura district recorded the highest number of incidents at the district level (24.76%, n=129), while Welikanda Divisional Secretariat recorded the highest number at that level (6.33%, n=33). The distribution of the incidents showed a clustered pattern with high intensities in Polpithigama, Welikanda, and Thanamalwila. The highest proportion of electrocution-induced elephant deaths (66.73%) occurred during the Maha season, which is Sri Lanka's main agricultural period. The rising prevalence of electrocution highlights policy and management gaps. Therefore, strengthening the Fauna and Flora Protection Ordinance and the Sri Lanka Electricity Act to reduce the elephant deaths from unauthorized electric fences is urgently needed. Further, effective community awareness and strict guidelines and monitoring of the private electric fences could reduce the deaths.

Keywords: *Electric fencing, elephant fatalities, human-elephant conflict, spatial patterns, temporal patterns*

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The impact of sunlight exposure time on microplastic release from bottled water in tropical climates

D.W.M.D.S. Chandrawansha[1*], T.G.M. Mihidula[1], L. Jayarathne[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

**dinukachandrawansha@gmail.com*

Microplastic (MP) contamination in bottled drinking water has become a significant environmental and public health concern; particularly in regions with a high plastic consumption, like Sri Lanka. While earlier studies have confirmed the presence of microplastics in bottled water, the effect of extended sunlight exposure on their release has not been thoroughly examined. This study investigates the effect of sunlight exposure time on the release of MP particles from 5 litre Polyethylenterepthalate (PET) water bottles in tropical climatic conditions. The experimental setup includes a total of thirty-two 5 litre water filled bottles. Direct sunlight exposure was applied to the bottles across varied time intervals of 1 day, 7 days, 14 days and 30 days respectively. The water samples were filtered using a 100 µm sieve pre and post exposure and the retained particles were quantified under an optical microscope. An initial concentration of 60 ± 8 MP particles per litre was observed, followed by an exponential increase of approximately 4.97% particles per litre per day, as described by the model $y = 57.181e^{0.045851x}$ ($R^2 = 0.099$), with respect to the duration of sunlight exposure. Subsequent Raman spectroscopy analysis identified the presence of photodegraded PET products (-COOH), Peak broadening and crystalline deformities. This confirmed the release of PET MPs from the bottles and the degradation of them into by-products. It is suggested that the photodegradation of PET MPs under sunlight is driven primarily by photo-oxidation, where UV irradiation generates reactive oxygen species that attack the PET polymer chains, causing chain scissions and resulting in new functional groups on the MP surfaces. These findings highlight potential health risks linked to prolonged storage of bottled drinking water under sunlight and emphasize the importance of raising public awareness.

Keywords: *Particle release, photodegradation, plastic count, polyethylene terephthalate*

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Taxonomy and habitat occupancy of *Thoracica* barnacles in selected coastal areas of Sri Lanka

K.G.C. Kumarasiri[1*], S. Jayakody[1], M. Fernando[2], W.M.H.K. Wijenayake[1]

[1]*Department of Aquaculture and Fisheries, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Sri Lanka*
[2]*Wildlife and Nature Protection Society, Battaramulla, Sri Lanka*

**1998chalithya@gmail.com*

Barnacles are highly specialized organisms frequently seen in diverse shallow coastal habitats. True barnacles that contain external calcified plates belong to infraclass *Thoracica*. Their last comprehensive assessment in Sri Lanka dates back to 1906. Therefore, a study was conducted to determine the species diversity and habitat occupancy in rocky, sandy, and muddy shores, as well as lagoons, estuaries, mangroves and harbours. Field surveys were conducted in 2024 along the southern, western, north western, northern and eastern coasts of Sri Lanka, covering 81 locations. Specimens were collected by scuba diving and beachcombing, and data on habitat, substrate type and GPS coordinates were recorded. Quadrat sampling (0.5*0.5 m) was conducted in triplicate for each site when colonies of barnacles were observed attached to rocky substrates. Species were identified through published keys and identification was verified through the World Registry of Marine Species. The current study identified 16 species from nine genera and five families. This includes nine species hitherto not recorded in Sri Lanka: *Amphibalanus venustus, A. reticulatus, A. variegatus, A. eburneus, Balanus trigonus, Chthamalus malayensis, Lepas indica, Semibalanus balanoides, and Yamaguchiella coerulescens*. Habitats where barnacles were recorded included rocky shores, coral reefs, mangroves, estuaries and lagoons, underwater concreted areas in harbours, floating objects, and crustacean exoskeletons. Beached barnacles were found attached to rubble, gastropod and bivalve shells, and marine waste. Amongst the recorded species *A. amphitrite* was the most widely distributed, being observed in 56.25% locations investigated, at a mean density (±SD) of 139.49 ± 22.49 m^{-2}. *A. amphitrite* was found distributed from shallow coastal waters to lagoons. This study updates the barnacle diversity and taxonomy in Sri Lanka and documents their occupied habitats. Future research includes expanding the study to other coastal areas and investigating barnacle associations with corals, sponges, turtles and marine mammals.

Keywords: *Cirripedia, habitat association, marine species, substrate type, WoRMS-based taxonomy*

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Potential of saltwater intrusion in coastal aquifers of the South Eastern coast of Sri Lanka: Water quality assessment

K.S. Wetthasinghe[1], S. Diyabalanage[1], T.B.N.S. Madugalla[1*]

[1]*South Eastern University, Sammanthurei, Sri Lanka*

**krishansanjaya1@gmail.com*

Coastal aquifers are vital sources of fresh water for many regions; however, they are increasingly threatened by saltwater intrusion driven by natural and anthropogenic processes. The current study hypothesized that saltwater intrusion significantly influences the hydrogeochemical characteristics of the southeastern coastal aquifers (Kalmunai to Akkaraipattu) of Sri Lanka, and aimed to assess its occurrence and extent. Groundwater samples were collected from 20 tube wells) and 26 dug wells and analyzed for major hydro-geochemical parameters, including pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Chloride (Cl^-), and salinity. The resulted data were mapped using GIS to interpret the spatial variation and extent of seawater intrusion. Correlation analysis was performed to examine the relationships among salinity, chloride concentration, and TDS, providing quantitative validation of the observed trends. The results revealed a distinct coastal to inland salinity gradient, with elevated salinity (0.168–0.41 psu) and chloride concentrations (789-2107 mg/dm^3) near to the coast, affirming a high level of seawater intrusion. The major hydro chemical signature of this intrusion was characterized by increased salinity and chloride concentrations, reflecting strong marine influence. GIS mapping further identified high risk zones of saltwater intrusion, particularly along the coastal belt. Compared to Puttalam and Jaffna regions, the present findings reveal a more pronounced salinity gradient, indicating increased vulnerability unique to the southeastern coastal belt. These observations highlight the urgent need for effective groundwater management through continuous monitoring, controlled abstraction, and managed aquifer recharge, to ensure sustainable freshwater use and long-term water security. Future research should focus on predictive modelling of saltwater intrusion under climate change scenarios, detailed geochemical classification of groundwater, and assessment of socio-economic implications for coastal communities to enhance long-term adaptation and resilience.

Keywords: *GIS mapping, groundwater, hydrogeochemical analysis, salinization, vulnerability*

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Spatial assessment of rooftop solar photovoltaic potential and CO_2 savings in Arasadi GND area, Sri Lanka

T. Keerthi[1*], K.I. Keshara[1], V. Vathsalayan[1]

[1]*Department of Earth Resources Engineering, University of Moratuwa, Sri Lanka*

[*]*keerthilojan@gmail.com*

In developing countries like Sri Lanka, electricity demand is continuously increasing, and this urges the need for renewable, cleaner energy solutions like rooftop solar photovoltaic (PV) systems. The Arasadi Grama Niladhari Division is one of the highly populated urban areas in Trincomalee District. This was the first rooftop-level solar PV assessment carried out in this region to assess rooftop solar potential and estimate carbon savings using geospatial methods. Updated building footprints were downloaded from OpenStreetMap data. Solar radiation, DEM, and aspect were derived from ALOS 12.5 m DEM and resampled into 5 m resolution. Suitable buildings were selected based on the following criteria: having an area greater than 100 m², slope less than 8°, and not facing north. Google Earth was used for confirming the buildings. The analysis revealed that 212 rooftops are suitable, with a total usable area of 37,433.8 m². Annual solar radiation averaged 750.7 kWh/m², and areas above this value were prioritised for solar PV installation. The estimation was made under an assumption of 15% panel efficiency and 80% system efficiency to produce electricity per building. A grid emission factor of 0.63 kg CO_2/kWh was used to calculate CO_2 savings. The estimated annual electricity generation was about 3.4 million kWh, with a potential reduction of 2,150 tonnes of CO_2 emissions. These results indicate strong potential for rooftop solar PV in the Arasadi GND area. This study also demonstrates the applicability of GIS in identifying solar potential quickly and effectively. Although some limitations exist, such as not accounting for rooftop shading and seasonal variation, the method provides a foundation for future work. Improvements such as economic assessments, roof condition mapping, and 3D modelling can enhance the results. These findings can support local authorities and investors in prioritising high-potential areas, contributing to Sri Lanka's goal of 70% renewable electricity by 2030 and promoting a cleaner, low-carbon future.

Keywords: *Building-level solar PV assessment, carbon emission reduction, cleaner energy solutions, geographic information systems, sustainable urban planning.*

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Estimating visitor carrying capacity for the Minneriya National Park

S.M.D. Suriyabandara[1*], T.U. Dilshan[2], D. Wijesinghe[3], D.K. Weerakoon[1], M.R. Wijesinghe[1]

[1]*Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Colombo, Sri Lanka*
[2]*Department of Wildlife Conservation, Sri Lanka*
[3]*International Union for Conservation of Nature, Sri Lanka*

**2019s17274@stu.cmb.ac.lk*

Tourism, globally, brings in much needed revenue for managing protected areas. Over visitation, however, could impose serious negative impacts on wildlife and habitats. Visitor carrying capacities are used to guide visitation inside protected areas, which attempts to maintain tourism at a level that is not detrimental to wildlife. In this study we calculate the carrying capacity for the Minneriya National Park (MNP), which supports the largest Asian Elephant gathering in the world. We estimate the physical carrying capacity (PCC) using the formula PCC= (L/Lu]) x RF, where L is the length of motorable safari trail around the Minneriya Reservoir where vehicles spend most of their time observing the elephants; Lu is the minimum distance to be maintained between two safari vehicles and RF is the rotation factor which is the number of times the park can be visited by the same group within a single day. The real carrying capacity (RCC) was then calculated using a correction factor which was based on behavioural changes in elephants when in close proximity to visitor vehicles. We used the percentage increase of agitation behaviour (Cf1) and reduction in locomotion behaviour (Cf2) due to the presence of safari vehicles within 30m from the animals. The results revealed that when maintaining a conservative inter-vehicle distance of 300m the RCC was 82 safari vehicles per day whereas maintaining 100m inter-vehicle distance resulted in an increase of up to 247 vehicles per day. Comparing these values with number of safari vehicles in 2024, highest number of vehicles were recorded in July (271 vehicles per day), which exceeded the calculated PCC and RCC values. Maintaining the numbers of vehicles within these limits is desired as it would bring in adequate revenue without imposing unfavourable impacts on the elephants which is the main attraction in the MNP.

Keywords*: Correction factor, impact on elephants, over-visitation, protected areas, safari vehicle*

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Estimation of total ecosystem carbon stocks in natural, restored mangroves and abandoned shrimp ponds in Pubudugama accelerated natural regeneration of mangroves site, Sri Lanka

D.K.G.K.D. Wijerathna[1]*, R.K. Bhomia[2], Richard A. MacKenzie[3], K.M.H.G.N.S.B. Kekulandara[4], H.G.W. Gajanayakage[4], P.M.W.S.R. Tissera[5], H.N.T.M. Kumarasiri[5], K.K. Dilshara[1], S. Jayakody[1]

[1]*Department of Aquaculture and Fisheries, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, Sri Lanka*
[2]*Center for International Forestry Research-World Agroforestry (CIFOR-ICRAF)*
[3]*Pacific Southwest Research Station, Hilo, USA*
[4]*Department of Forest Conservation, Sri Jayewardenepura Kotte, Sri Lanka*
[5]*Wildlife and Nature Protection Society, Sri Lanka*

**kaushalyadhananji2000@gmail.com*

Mangrove ecosystems are one of the most productive ecosystems and a vital blue carbon sink that sequesters atmospheric carbon while mitigating climate change. The total extent of mangroves in 2022 was 16,615 ha, representing 0.25% of the total land of Sri Lanka. Approximately 25% of mangroves were destroyed from 1980 to 2005. Large extents of mangroves are destroyed due to aquaculture, mainly in the Puttalam district. Today, efforts are underway to restore mangroves globally. In Pubudugama, in Sri Lanka's Northwestern Province, accelerated natural regeneration is attempted in abandoned shrimp ponds. This study was conducted to determine the Total Ecosystem Carbon Stocks in natural, degraded, and restored areas in 2019 and 2024. Experimental design involved setting up 50*50m major plots for each stratum, with five subplots and each subplot marked with 2m and 7 m radius circular boundaries. Above-ground biomass, below-ground biomass, and downed wood biomass were measured. Soil samples were collected up to one meter. Soil carbon was determined through loss on ignition, and vegetation biomass was estimated using allometric equations. The findings revealed that Total Ecosystem Carbon Stocks (±SD) levels are 860±201, 443.8±122.6, 625±174, and 571±266 Mg/ha, in natural, degraded, and 2019, and 2024 restoration sites, respectively, with no significant differences across four strata ($P>0.05$). Conversely, a higher amount of above-ground carbon content (59.41 %) and below-ground carbon content (77.47 %) was exhibited in the 2019 restored area. The degraded area contained 100% of soil organic carbon, while all forms of carbon were present only in the natural strata. These findings show the carbon potential of mangroves in the Pubudugama area, as well as the benefits of restoration in terms of replacing lost carbon reserves. The findings additionally indicate that in order to prevent additional soil carbon degradation, disturbed areas should be restored.

Keywords: *Above-ground carbon, below-ground carbon, blue carbon, total organic carbon*

Acknowledgment: This study was funded by the United States Forest Service and facilitated through the Wildlife and Nature Protection Society (WNPS) and SLT Mobitel blue carbon scholarship.

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Validating a self-made sampler and a simplified model for suspended sediment monitoring in palmate and linear canals dug for mangrove restoration

A. Fernando[1*], S.K. Gunawardana[1], A.M.S.N. Abeysinghe[1], S. Jayakody[2]

[1]*Curtin University, Colombo, Sri Lanka*
[2]*Wayamba University of Sri Lanka, Makandura, Sri Lanka*

[*]*20059105@student.curtin.edu.au*

Linear and palmate canals are constructed globally to restore hydraulic connectivity in degraded mangrove areas. However, in Sri Lanka, costly measurement tools limit understanding of Suspended Sediment (SS) dynamics during canal construction, often resulting in insufficient sedimentation that either deprives mangroves of nutrients or excessive sedimentation that smothers seedlings. Therefore, this study evaluated the usability of a low-cost, self-made bottle sampler designed for flow and sampler-mouth velocity parity, to obtain accurate in-field Suspended Sediment Concentration (SSC) measurements. Concurrently, a Simplified Model (SM) was derived from the standard 3-Dimensional SS Transportation Equation (3-DE) for low-overhead SS prediction. In February 2025, 264 SSC samples were collected and weighed across 23 locations in the Anawilundawa Restoration Site. SSC distribution was right-skewed, with means of 0.086 g L^{-1} (entire site), 0.088 g L^{-1} (palmate canals), and 0.0722 g L^{-1} (linear canals). SSC driving factors were scale-dependent, with tidal forces dominant across the site. This aligns with literature about the San Francisco Bay; supporting the sampler's usability. Intertidal SS trapping was minimal in the canals (median: 1.19 mg L^{-1}), when compared to studies done in Florida, USA, likely due to underdeveloped mangrove root structures. To obtain the SM, the 3–DE was integrated along the depth axis and simplified by assuming negligible lateral SS exchange. 132 instances were modelled and compared with measured counterparts. Sequential SSC calculations along flow correlated strongly with measurements (Pearson $r = 0.97$; Spearman $\rho = 0.89$), but modelled SSCs were consistently 22.3% lower, due to assuming negligible lateral exchange and collapsing vertical fluxes into a single term. The alignment of measured and modelled SSCs, mutually supports sampler and SM usability. Promising future research includes: refining the model by integrating vertical SS flux as an inverse Beta distribution from the canal bed and testing SS retention versus critical bed shear stress in the field.

Keywords: *Accelerated natural regeneration, palmate canals, resource-limited monitoring, suspended sediment, suspended sediment modelling.*

Acknowledgement: Authors wish to acknowledge the valuable material and financial support provided by the Wildlife and Nature Protection Society of Sri Lanka to conduct this research.

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Mineralogical and pedogenetic characterization of serpentinite soils at Ginigalpelessa, Southern Sri Lanka

S.P.T.S. Wickramasinghe[1], P.L. Dharmapriya[1*], K.T.P. Jayaweera[1,2], R. Chandrajith[1], S.P.K. Malaviarachchi[1], H.M.T.G.A. Pitawala[1]

[1]*Department of Geology, Faculty of Science, University of Peradeniya, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*

**prasannad@sci.pdn.ac.lk*

Carbonated serpentinite ultramafic bodies are exposed at several localities near the Highland–Vijayan Complex thrust zone in Sri Lanka (at Ginigalpelessa, Indikolapelessa, Ussangoda, and Yudaganawa) and at Rupaha in the Highland Complex and except Rupaha, other localities are featuring well-developed serpentinite soil regolith. Whilst major and trace element concentrations have been studied, systematic investigation of mineralogical composition and pedogenetic processes remains limited. This study analysed the mineralogy and pedogenesis of serpentinite soils collected in Ginigalpelessa using an auger hole reaching 60 cm depth (excluding the top 10 cm) and slightly weathered serpentinite bedrock samples crosscut by carbonate and chert veins. Field observations indicate reddish-brown soil with thin vegetation and the presence of brown to black iron nodules. Quartz, chert, and magnesite fragments are abundant in the soil. Petrographic observations and XRD analyses of bedrock identified primary minerals including antigorite, chrysotile, forsterite, magnesite, chromite, chlorite, brucite, enstatite, talc, quartz, magnetite, and hematite. XRD analysis of serpentinite soils revealed distinct vertical mineralogical profiles indicative of progressive weathering. Near-surface horizons (10–20 cm) were dominated by secondary clay minerals such as kaolinite and chlorite, with goethite, hematite, quartz and relict chromite. Intermediate layers (20–40 cm) exhibited nontronite (Fe-rich smectite) with magnetite and preserved antigorite, whilst deeper layers (40–60 cm) retained antigorite, magnetite, chromite, kaolinite, and nontronite. These mineralogical patterns suggest pedogenesis is driven primarily by hydrolysis of serpentine-group minerals, releasing and leaching magnesium and silica through weathering. This leaching promotes kaolinite and nontronite formation, whilst partial iron retention and oxidation produce goethite and hematite accumulation near the surface, indicating incipient lateralization. Chromite persistence reflects weathering resistance, and crosscutting carbonate and chert veins may locally alter pH and silica availability, affecting clay mineral transformations. These findings reveal progressive serpentine mineral breakdown through hydrolysis, causing magnesium and silica leaching and producing secondary minerals, whilst iron oxidizes to form goethite and hematite and resistant chromium-rich minerals remain enriched.

Keywords: *Clay minerals, hydrolysis, mineralogy, serpentine weathering, XRD analysis*

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Assessment of organic fertilizer derived from fish-cut washed wastewater on the growth and yield performance of tomato (*Solanum lycopersicum*)

W.I. Sewwandi[1], G. Naveendrakumar[1*]

[1]*University of Vavuniya, Vavuniya, Sri Lanka*

**2019asb19@stu.vau.ac.lk*

Fish-cut washed wastewater is a by-product generated during fish cleaning and processing, particularly in canning industries. This wastewater contains high levels of organic matter such as blood, tissue residues, fats, proteins, nitrogen, and phosphorus, contributing to elevated biochemical oxygen demand (BOD) and chemical oxygen demand (COD). If not treated properly, it can cause serious environmental pollution. Effectively processed, the resulting sludge can serve as a nutrient-rich organic fertilizer, offering a sustainable approach for waste management and agricultural enhancement. This study focuses on characterizing the sludge from a fish-cut wastewater treatment plant within the fish processing industry. The main objectives are to assess the nutrient content and safety of the treated sludge, prepare a fertilizer mix, and evaluate its effectiveness through tomato plant growth trials. Initial analysis showed that the sludge had a high moisture content (67%) and was moderately saline (electrical conductivity of 3.8 dS m^{-1}), with a slightly acidic pH (6.7). Pathogenic organisms such as *Salmonella* and *E. coli* were absent, while faecal coliforms were present at low concentrations (3.6 MPN/g), suggesting acceptable microbiological safety. Chemical analysis revealed the presence of 469.11 mg/kg of potassium, 0.2 mg/kg of nitrate, 0.4 mg/kg of phosphate, and 3.6% total organic carbon However, heavy metals such as Zinc (3707 mg L^{-1}) and Chromium (47 mg L^{-1}) were elevated, posing potential environmental risks if the sludge is used as fertilizer without proper mitigation. Wastewater analysis confirmed a high organic load (chemical oxygen demand of 395 mg/L and five days biochemical oxygen demand of 97 mg L^{-1}) but showed no detectable heavy metals, indicating effective contaminant removal. The sludge presents some potential for agricultural reuse; however, further treatment and monitoring are essential to address heavy metal concerns and ensure environmental safety.

Keywords: *Heavy metals, nutrient-rich organic fertilizer, sludge characterization tomato growth trails.*

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Effects of Different Types of Organic Manure on Soil Invertebrate Diversity, Abundance, and Quality of Maize Cultivation

S. Siyamalan[2], R. Thusyanthini[1], A.G.S.D. De Silva[1*]

[1]*Sri Lanka School of Agriculture, Department of Agriculture, Paranthan, Sri Lanka*
[2]*District Agriculture Training Center, Vaddakkachchi, Department of Agriculture, Sri Lanka*

**gihanshyamal@gmail.com*

This study aimed to evaluate the impact of different types of organic manure on soil invertebrate abundance, diversity, and soil quality in maize cultivation at Sudumalli, Jaffna District, Northern Province of Sri Lanka. The experiment design included a Randomized Complete Block Design (RCBD) with three replicates and six treatments: cow dung (T_1), goat manure (T_2), poultry manure (T_3), enriched compost (T_4), commercial goat manure compost (T_5), and a control (T_6). Soil samples were collected after crop harvest, and invertebrates were extracted using hand sorting and a simple handmade Berlese-Tullgren funnel. Seven invertebrate taxa were identified, including Lumbricidae, Chilopoda, Diplopoda, Isopoda, Collembola, Symphyla, and Diplura, with Lumbricidae, Diplopoda, and Diplura being ubiquitous. One-way Analysis of Variance (ANOVA), with the Holm-Sidak post hoc test, was performed to identify significant differences among the treatments with respect to community diversity, density and Soil Biological Quality (QBS) indices. Invertebrate density ranged from 148 to 874 individuals m^{-2}, with T_2 (goat manure) showing the highest density and T_6 the lowest. Taxonomic richness was significantly higher in organic manure treatments, with T_1 and T_2 exhibiting the highest richness. Shannon and Simpson diversity indices indicated the highest diversity in T_3 and the lowest in T_6. The Menhinick and Pielou indices showed the highest evenness in T_3 and the lowest in T_6. The QBS index was significantly higher in T_1, T_2, and T_3 compared to other treatments, reflecting the improved biological quality of the soil in organic manure-treated plots. These findings demonstrate that organic manure applications enhance both soil invertebrate density and diversity, contributing to improved soil quality in maize cultivation.

Keywords: *Hand sorting, soil biodiversity indices, soil bioindicators, soil fauna*

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Poisonous-edible look-alike mushrooms in Sri Lanka and how to avoid them

T.K. Agalawela[1,3], S. Wijesundara[1*], S.C. Karunarathna[2], N. Wijayawardene[2,4], V.N.S. Sirimalwatta[3], A. Ediriweera[4,5]

[1]*National Institute of Fundamental Studies, Hantane Road, Kandy*
[2]*Center for Yunnan Plateau Biological Resources Protection and Utilization, College of Biology and Food Engineering, Qujing Normal University, Qujing, Yunnan*
[3]*Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya*
[4]*Tropical Microbiology Research Foundation, 96/N/10, Meemanagoda Road, 10230 Pannipitiya, Sri Lanka*
[5]*B-Hood Myco-Tropic Innovations, 1st Lane, Issadeen Town, Matara, Sri Lanka.*

[*]*sirli.wi@nifs.ac.lk*

Although only 1% of the more than 14,000 known species of macro-fungi produce fruiting bodies that are deadly or potentially deadly to humans, hundreds of people worldwide die annually from mushroom poisoning. Insufficient knowledge, unclear taxonomy, rising consumption of fungi, and misleading folklore are all contributing factors to these deaths. As a mycophilic country, Sri Lanka is home to various species of edible mushrooms, such as *Calvatia candida, Pleurotus giganteus, Schizophyllum radiatum, Termitomyces heimii, T. microcarpus,* and *Volvariella volvacea.* Potentially poisonous mushrooms are reported in the genera; *Amanita, Inocybe,* and *Chlorophyllum*. *Amanita* is frequently confused with edible mushrooms, such as puffballs and *Chlorophyllum* species, particularly the common toxic *Chlorophyllum molybdites* (the green-spored parasol or vomiter), which are often mistaken for prized edible mushrooms like the true parasol mushroom (*Macrolepiota procera*). This article aims to compile Sri Lankan macrofungal species known to be responsible for poisoning and raise awareness of food safety issues related to poisonous mushrooms, as well as increase the knowledge based on this topic for the general public and scientific community. We list the potential toxic mushrooms found in Sri Lanka, along with case studies that provide their main distinguishing features, ecology, and distribution. We also highlight the danger of look-alike edible species, aiming to raise awareness and caution among our readers. Additionally, we discuss methods for preventing future instances of poisoning and the necessity of developing regional-level educational and awareness programs, especially in rural areas where they would be most beneficial.

Keywords: *Awareness, Ceylon, deadly fungi, macro-fungi, mushroom poisoning*

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Evaluating the antibacterial efficacy and cytotoxicity of *Senna occidentalis* seed extract at varying concentrations against respiratory pathogens associated with pneumonia

A.D. Daniel[1*], K. Jeyakumar[1], R.G.R.M. Rajapaksha[1], I.P.A.M. Samaratunga[1], L.H.A.H.W. Karunarathna[1], V.S. Kodikara[1], J.M.K.J.K. Premaratne[2]

[1]*KAATSU International University, Department of Bio Medical Science, Sri Lanka*
[2]*Wayamba University, Livestock and Avian Science BVSc MPhil PhD, Sri Lanka*

[*]*anuradhadaniel2000@gmail.com*

The increasing concerns over the adverse effects of synthetic drugs have led to growing interest in plant-based alternatives with fewer side effects. Among medicinal plants, Coffee Senna was selected due to its traditional use in treating respiratory ailments and reported antibacterial and anti-inflammatory properties, making it a promising candidate over others. This study aimed to evaluate the antibacterial efficacy and cytotoxicity of *S. occidentalis* seed extracts against common pneumonia-associated pathogens. Dried seeds were extracted using ethanol, methanol, and distilled water. Each extract was tested at crude (100%) and diluted concentrations (75%, 50%, and 25%) using the agar disk diffusion method against four bacterial strains: *Staphylococcus aureus* (ATCC 43300), *Klebsiella pneumoniae* (ATCC 700703), *Escherichia coli* (ATCC 25922), and *Pseudomonas aeruginosa* (ATCC 9027). Ciprofloxacin and erythromycin served as positive controls, while sterile saline was used as a negative control. Antibacterial activity was assessed by measuring zones of inhibition after 24 hours at 37°C. The ethanol extract at full concentration demonstrated the highest activity, with inhibition zones of 6.33–10.67 mm. The methanol extract showed notable activity, particularly against *P. aeruginosa* (13.67 mm), while the aqueous extract displayed moderate activity. Results were consistent across replicates, and differences in inhibition zones were statistically significant ($p < 0.05$) for ethanol extract compared to controls. Cytotoxicity was evaluated using a Brine Shrimp Lethality Assay. The ethanol extract exhibited an LC_{50} of 458.03 µg/mL, whereas methanol and aqueous extracts showed higher toxicity, with LC_{50} values of 230.26 µg/mL and 216.55 µg/mL, respectively. This study provides novel insight by comparing antibacterial efficacy and cytotoxicity of different solvent extracts of *S. occidentalis*, highlighting ethanol extract as both potent and relatively safe, which has not been extensively reported. Future studies should focus on isolating bioactive compounds, evaluating in vivo efficacy, and exploring potential synergistic effects with standard antibiotics to maximize therapeutic benefits.

Keywords: *Escherichia coli, klebsiella pneumoniae, pseudomonas aeruginosa, staphylococcus aureus, zone of inhibition*

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Analysis of protein content in chicken eggs produced under local feeding practices in Western Province, Sri Lanka

P.D.M.K.C. Pathirage[1*], M.D.C.K. Peiris[1], M.A.G.S. Madhuwanthi[1], I.D. Manathunga[1], M.C.P. Dharmasena[1], D.J.B. Arachchi[1], S.C. Ganguli[1], A.K.D. Silva[1], R.M.D. Rachalle[1], W.G.C.S.B. Sumanasiri[1]

[1]*Faculty of Graduate Sciences, University of Kelaniya, Sri Lanka*

[*] *chathurya2525@gmail.com*

Eggs provide all the essential amino acids for human intake. Different feeding practices affect the egg protein content. However, there is limited information on how local feeding practices affect egg quality in small-scale farms in Western Province, where poultry production widely varies from small-scale to large-scale farms. This study was conducted to assess the protein content in commercially available chicken eggs produced under different local feeding practices in Western Province. This was a cross-sectional observational study analysing 156 eggs with different weight categories from 13 different farms in Western Province, with statistical power > 80%. The egg protein content was measured using the UV spectrometric method at 280 nm and 260 nm. A self-administered questionnaire was utilised to collect information about the feeding practices, and data were cross-checked with feed labels and visual inspection. The median total egg protein content was 8.27g, with 7.24 g and 0.91 g in egg white and yolk, respectively. There was a significant positive correlation ($r = 0.584$, $p < 0.05$) between egg weight and protein content. The mean feed protein percentage was 17.9%. Out of 13 farms, 61.5% used protein supplements. Only the use of protein supplements and feed protein percentage ($p < 0.05$) significantly predicted the total and egg white protein content. The eggs from hens provided with a combination of fish oil and fish meal had the highest median total (11.08 g) and egg white protein content (10.7 g), enhancing the efficiency of protein utilisation and greater protein deposition in eggs. In conclusion, larger eggs are better sources of protein for the diet and using protein supplements with fish oil and increasing feed protein percentage enhances the egg protein content. Biochemical mechanisms of protein deposition, as well as cost–benefit analyses of feeding strategies, can be explored in future research.

Keywords: *Feed protein percentage, protein composition, protein supplementation, UV spectrometry*

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Effect of the treated period of plasma-activated water for seed germination and the seedling growth of *Vigna unguiculata*

T.P.G.N.T. Alvis[1], M.A.M. Kumari[1], R.M.C.S. Ratnayake[1*]

[1]*Department of Plant and Molecular Biology, University of Kelaniya, Sri Lanka*

[*]*ratna@kln.ac.lk*

Production of quality foods in adequate amounts is very important for ensuring food safety. *Vigna unguiculata* (cowpea) is a nutrient-rich legume that is widely cultivated in Sri Lanka. However, low seed germination and seedling growth reduce the crop productivity. Plasma activated water (PAW) is used in agriculture for enhance seed germination and seedling growth. It is generated by reacting plasma with distilled water. Paw contains reactive oxygen and nitrogen species. This study focused to evaluate the effect of PAW on seed germination and thereby determine the best treated period for seed germination, and seedling growth. Healthy and surface-sterilized *V. unguiculata* seeds (120/treatment) were immersed in the following PAW treatments; control (distilled water - untreated), 5 min, 10 min, and 15 min. The treated seeds were incubated in petri plates layered with moistened filter papers with three replicates. The observations and data collection were done daily, and the seed germination parameters, such as Mean Germination Index (MGI), Mean Germination Rate (MGR), Mean Germination Time (MGT), and Mean Coefficient of Velocity of Germination (MCVG), were calculated. After four days the seedling growth was also measured. All the data were analyzed using one-way ANOVA at $\alpha = 0.05$ followed by Tukey pairwise comparison using "R" statistical software. Seeds immersed in 10 minutes treatment showed a significant difference in mean germination index ($p = 0.001$, $F = 29.83$) and mean germination rate ($p = 0.009$, $F = 7.85$) compared to the control. However, the highest mean germination index (21.0 ± 1.1), the highest mean germination rate (90.0 ± 10.0), and the highest mean seedling growth (7.6 ± 0.7 cm) were recorded by *V. unguiculata* seeds treated for 10 min in PAW. Therefore, the most effective PAW treatment for enhancing seed germination and seedling growth of *V. unguiculata* is 10-minute treatment for practical applications. This is an eco-friendly and cost effective method and can be further expanded for field experiments in future.

Keywords: *Eco-friendly, germination enhancement, mean germination index, mean germination rate, sustainable agriculture*

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Evaluation of Growth and Survival of Mrigal and GIFT at Selected Stocking Densities in Pond-Based Aquaculture

V. Kalaivizhi[1*], G. Anitha[2], P. Susantha[1], L. Thasanthan[3]

[1]*Department of Animal Science, Faculty of Agriculture, University of Jaffna*
[2]*Aquaculture Development Centre, Iranaimadu, Kilinochchi*
[3]*Department of Radiography/ Radiotherapy, Faculty of Allied Health Sciences, University of Peradeniya*

[*]*angelinakalaivizhi@gmail.com*

Optimizing stocking density is crucial for sustainable aquaculture of Mrigal (*Cirrhinus cirrhosus*) and Genetically Improved Farmed Tilapia (GIFT) in Sri Lanka, where freshwater pond systems support food security and rural livelihoods. This study evaluated the effects of stocking density on growth, survival, and water quality to develop science-based management protocols for high-yield, ecologically balanced production. The objective was to determine optimal stocking densities for Mrigal and GIFT by assessing their impacts on growth performance (specific growth rate, weight gain), survival rates, and water quality parameters (dissolved oxygen, ammonia, pH), providing baseline insights for sustainable stocking density recommendations. Experiments were conducted at the Aquaculture Development Centre, Iranaimadu, using concrete ponds with mud bottoms. Each tank covered 460 m² with a uniform depth of 6 ft (1.83 m), and two tanks per species were used to evaluate two stocking densities. A completely randomized design was employed with four replicates per treatment. Mrigal and GIFT fry were stocked at densities of 217 fry/m² and 174 fry/m², reared for 42 and 25 days, respectively, and fed commercial feed thrice daily. Feed particle size and feeding rate varied by life stage: fry received feed at 1/5 of body weight, and fingerlings at 1/3, per feeding. Weekly measurements included growth, survival, and water quality. Data were analyzed using one-way ANOVA and regression to evaluate density effects and length–weight relationships. Mrigal performed optimally at 217 fry/m² with 74.22% survival and 5.48% specific growth rate, while GIFT performed better at 174 fry/m², achieving 73.63% survival and 10.4% specific growth rate. Both species showed isometric growth ($b \approx 3$). Water quality showed significant variation in DO, TDS, and conductivity, while pH (7.6–8.0) and ammonia (<0.02 mg/L) remained optimal. These species-specific guidelines can enhance productivity and sustainability in Sri Lanka's aquaculture sector.

Keywords: *Growth performance, pond system, species, survival rate, water quality.*

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Modelling for optimizing nitrogen fertilizer rates for maize in dry zone of Sri Lanka under current and future climate scenarios

H. Uduwawala[1*], S.H.N.P. De Silva[2], W.C.P. Egodawatta[1], B.A.I.S.L. Bandara[1]

[1]*Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[2]*Department of Crop Sciences, Faculty of Agriculture, University of Peradeniya, Sri Lanka*

**hashanuduwawala@gmail.com*

Maize (*Zea mays* L.) is a staple upland crop that plays a crucial role in food security, especially in Sri Lanka's dry zone, which is highly sensitive to climate change. However, current maize fertilizer recommendations have not accounted for climate change, leading to reduced yields and negative environmental impacts. This study modelled and optimized nitrogen (N) fertilizer rates for maize in Sri Lanka's dry zone under current and future climate scenarios using the Agricultural Production Systems Simulator. The years 2050 and 2100 were selected as benchmark periods representing mid and late-century climate projections commonly used in global climate assessments. Simulations for the Maha and Yala seasons used site-specific soil data from Mahailuppallama, a representative site in the dry zone of Sri Lanka, along with weather and management data typical of the region. Nitrogen fertilizer rates were developed by combining different basal and top-dressing ratios to represent a wide range of rates. Findings indicated that under current conditions, applying 345 kg ha^{-1} of N in the *Maha* season yields 2,625.10 kg ha^{-1} with a median N leaching value of 11.3 kg ha^{-1}. In *Yala*, 435 kg ha^{-1} of N achieves 3,174.46 kg ha^{-1} yield and 0.4 kg ha^{-1} leaching. These nitrogen rates were identified as optimal, with further increases in nitrogen rates offering no yield benefit but increasing leaching. As per anticipated alterations in climate scenarios for 2050, a slightly increased optimal yield is expected with similar N rates. In 2100, particularly in *Yala*, the simulated yield increased with higher N rates (375 kg ha^{-1} in *Maha* and 465 kg ha^{-1} in *Yala*), despite increased leaching. However, these projections may vary with future changes in soil quality, management practices, and maize varieties. The study emphasizes climate-adaptive nitrogen management to sustain maize yields and guide sustainable practices in Sri Lanka's dry zone.

Keywords: *Apsim maize model, climate change, climate-specific optimization, leaching, nitrogen management*

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Assessment of the quality of vegetable seeds, commercially sold in Anuradhapura District: strengthening seed system security to safeguard food security

B.A.I.S.L. Bandara[1*], C.K. Beneragama[2], W.C.P. Egodawatta[1], L.M. Rankoth[2]

[1]*Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[2]*Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka*

[*]*ishabandara20@gmail.com*

Seed system security is a major concern as it contributes to ensure the food security in Sri Lanka. Commercial seeds are often reported to have low germination rates, which may lead to suboptimal yields and food insecurity. This study aimed to evaluate the physiological quality including the germination potential and vigor of vegetable seeds from various commercial seed brands, available for sale, in the Anuradhapura District. In this study, triplicate samples of 45 seed lots representing 18 crops were obtained using a mystery shopper approach for laboratory evaluation. Germination rates and seedling vigor were tested according to the standards of the International Seed Testing Association at the Central Seed Testing Laboratory. Additionally, the polyphasic OJIP chlorophyll fluorescent transient analysis was performed on seedlings to assess vigor. The results revealed that germination percentages ranged from 0% to 95% across crops, with no commercial brand showing consistent germination. Moreover, 78% of the seed samples failed to achieve the germination percentage stated on the seed packs under standard laboratory conditions. Associations generated through Chi-square analysis indicated a significant difference ($p<0.05$) between the label information and the measured parameters including germination rate, seedling vigor, and root-to-shoot ratio. OJIP chlorophyll fluorescence analysis showed that the tested seeds had lower seedling vigor compared to standard seeds, as indicated by reduced performance index values. These findings suggest that the physiological quality of commercially available vegetable seeds in Anuradhapura was highly inconsistent, thus information on labels often failed to reflect seed performance accurately. This inconsistency poses significant risks for farmers who rely on quality indicators on labels. Strengthening quality control regulations and their proper implementation in Anuradhapura District is essential to enhance transparency and reliability in the seed supply chain, thereby improving seed system security and safeguarding food security.

Keywords: *label information, OJIP analysis, seed germination, seedling vigour*

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Assessment of the properties of jellyfish *Acromitus flagellatus* gelatine-based biodegradable films as food packaging material

R.A.S.N. Ranasinghe[1], W.L.I. Wijesekara[1], S.A. Senanayake[1], P.R.D. Perera[1], M.M. Pathmalal[2], R.A.U.J. Marapana[1]*

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka*
[2]*Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka*

**umarapana@sci.sjp.ac.lk*

The frequent blooms of Jellyfish *Acromitus flagellatus*, which is considered a bycatch has been reported in Sri Lankan coastal areas, interfering with the aquaculture and fishing operations in those regions. As an eco-friendly alternative to synthetic packaging materials, this study investigated the possibility to prepare biodegradable films from *Acromitus flagellatus*-based gelatine, that were extracted using hot water extraction at 60 °C for 8 hours and microwave-assisted extraction (2450 MHz, 900 W at 50% power level for 3 minutes), and their properties were compared with the films prepared from the gelatines of cold-water fish skin and porcine skin. Jellyfish gelatin-based films were noticeably darker than both fish and porcine gelatin films. The tensile strength (TS) and elongation at break (EAB) were significantly different ($p < 0.05$) among different gelatine films. Jellyfish gelatin films exhibited lower TSs compared to porcine gelatin films, but higher than fish gelatin films. Of the two Jellyfish gelatine film types, microwave extracted gelatin-based films showed noticeably higher TS compared to the films prepared from hot water extracted gelatin. Both types of Jellyfish gelatine-based films showed higher EABs compared to those of fish and porcine gelatin films. The water vapour transmission rates of both jellyfish gelatine films were more than two times higher than the other two film types. The gelatine films from fish and Jellyfish were completely water soluble within 24 hours and fully biodegraded after 24 hours of soil incorporation. The scanning electron microscopy showed that the surface structures of gelatine films of Jellyfish were porous and granular, while their internal structures were less compact compared to the gelatine films of fish and porcine. Hence, it could be concluded that Jellyfish *Acromitus flagellatus*-based gelatine can successfully be used for the formation of biodegradable films, while some modifications are needed to improve their water barrier properties.

Keywords: *Eco-friendly packaging, elongation at break, solubility, tensile strength, water vapour transmission rate*

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Evaluation of antixenosis resistance of selected Sri Lankan traditional rice varieties against brown plant hopper *(Nilaparvata lugens)*

W.J.A.P.M. Jayasooriya[1], D.M.A.D. Bandara[1], K.S.J. Madushanka[1], K.P.L. Arosha[1], W.L.S.M.I.D.M. Thilakarathne[1], D. Ratnasekera[2*], A. Mannakkara[2]

[1]*Faculty of Graduate Studies, University of Ruhuna, Matara, Sri Lanka*
[2]*Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka*

**disnaratnasekera@gmail.com*

Brown planthopper (BPH) *Nilaparvata lugens* (Stål) is a major pest of rice, causing substantial yield losses in Sri Lanka. The diversity of traditional rice varieties offers an invaluable genetic reservoir for exploring BPH-resistant traits. This study was conducted at the Faculty of Agriculture, University of Ruhuna, Sri Lanka to evaluate the antixenosis resistance of five traditional rice varieties (Pachchaperumal, Suwadal, Suduheenati, Rathkara, and Kalu heenati) sourced from the Plant Genetic Resources Centre (PGRC), Gannoruwa, Sri Lanka in comparison with susceptible check (Bg 380) and resistant check (Bg 379-2) with 4 replicates in completely randomized design. A cage experiment was set up to assess BPH settling preference at 12, 24 and 48 hours and egg deposition. Data were analyzed using ANOWA and significant means were separated by Duncan's Multiple Range Test (DMRT) at $p<0.05$. Bg 380 recorded, highest BPH counts and egg numbers as most susceptible line (5.47±0.18 adults/plant; 75.45±2.78 eggs/plant). In contrast, Suwadel (2.64±0.18 adults/plant; 20.72±1.53 eggs/plant) exhibited lowest BPH preference and egg deposition, grouping with resistant check Bg 379-2 (3.62±0.18 adults/plant; 40.18±1.53 eggs/plant) most resistant category according to DMRT ($p<0.05$). Rathkara (3.40±0.18 adults/plant; 23.55±1.25 eggs/plant) and Suduheenati (3.46±0.18 adults/plant; 25.58±2.19 eggs/plant) demonstrated moderate resistance, while Pachchaperumal (3.98±0.18 adults/plant; 35.65±2.41 eggs/plant) and Kaluheenati (3.71±0.18 adults/plant; 34.10±1.92 eggs/plant) showed intermediate susceptibility. The focus on traditional varieties in this study due to their extensive genetic diversity, which is crucial for resilience against pests like BPH. This diversity not only enhances their immune repertoire but also reduces reliance on chemical pesticides, contributing to sustainable agriculture and food security. The identification of strong antixenosis resistance in Suwadel (2.64±0.18 adults/plant; 20.72±1.53 eggs/plant) underscores potential of these traditional varieties as valuable genetic resources for BPH-resistant development by gene pyramiding, supporting integrated pest management strategies in Sri Lanka.

Keywords: *Antixenosis resistance, bph preference, nilaparvata lugens, oryza sativa*

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Analysis of functional properties of protein extracted from horse gram (*Macrotyloma uniflorum*)

I.M. Abeysingha[1], E.R.J. Samarakoon[1]*, T.R.L. Senadheera[2], K.H.M.L.S. Ketakumbura[3]

[1]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*Department of Biochemistry, Memorial University of Newfoundland*
[3]*Food Research Unit, Gannoruwa, Peradeniya, Sri Lanka*

**rasanjalis@agri.pdn.ac.lk*

Horse gram (*Macrotyloma uniflorum*) is an underutilized legume known for its high protein content. This study investigates the functional properties of protein isolate extracted from the horse gram variety ANK Brown cultivated in Sri Lanka and compared it with a commercially available soy protein isolate (SPI). Horse gram protein isolate (HGPI) was extracted from horse gram seed flour using the alkaline extraction–isoelectric precipitation method. Water absorption capacity (WAC) and oil absorption capacity (OAC) of HGPI and SPI were tested only under their native pH conditions, which were 6.5 and 7.2, respectively using a centrifugation based gravimetric method. Solubility, foaming activity (FA), foaming stability (FS), emulsion activity (EA), and emulsion stability (ES) were tested over a range of pH (pH 2– 10). Gelation abilities of protein isolates were evaluated through visual observation of gel formation under varying ionic strength and temperature conditions. HGPI exhibited a WAC of 1.91±0.02 g g^{-1} and an OAC of 2.03±0.10 g g^{-1} at their native pH. The solubility profile of HGPI demonstrated a distinct U-shaped trend, with a minimum solubility observed at pH 4 as 0.02±0.00% and a maximum solubility at pH 10 as 0.87±0.01%. The lowest FA, FS, EA, and ES of HGPI were at pH 4 and increased gradually from pH 4 to pH 10. According to the comparative analysis, WAC and OAC of HGPI and SPI were not significant ($P > 0.05$). Moreover, HGPI exhibited significantly lower ($P < 0.05$) solubility than SPI across all pH levels except pH 4.0, and showed significantly lower ($P < 0.05$) FA, FS, EA, and ES than SPI throughout the evaluated pH range. HGPI demonstrated limited gelation ability in contrast to SPI. Although HGPI showed limited functional properties compared to SPI, its own functionality can be enhanced by adjusting the pH away from 4.0, supporting its potential use in food applications.

Keywords: *Physico-chemical properties, plant protein, protein extraction, soy protein isolate*

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Evaluation of flax mucilage *(Linum usitatissimum)* as a fat absorption reducer in fried cassava chips

K.S. Madushika[1], J.M.J.K. Jayasinghe[1*]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

**jagathj@sci.sjp.ac.lk*

Many studies have found that fried food contains more than 50% excessive oil, and it can cause health problems. The objective of this study is to evaluate the effectiveness of flaxseed mucilage (FM) in reducing oil absorption (OA) during the deep-frying of cassava chips (CC), while analyzing the nutritional, functional, and physicochemical properties of the extracted FM. Phytochemical properties were evaluated using an ELISA and a UV-visible spectrophotometer. After the FM was extracted using the hot water extraction method, its properties were analyzed. Using a dipping method, FM was applied to CC at varying concentrations (0.5%, 1%, and 2%). The reduction in OA for each treated sample was determined using the Soxhlet extraction method. To evaluate the practical effectiveness, the FM-coated sample was compared with a market CC sample (MS). FM showed low moisture content (5.76%), with moderate crude fiber content (7.94%). The mucilage showed functional properties with high oil holding capacity (6.12 g/g), water-holding capacity (12.17 g/g), and swelling capacity of 4.83 ml/g. The antioxidant activity was recorded as 5.99 mmol TE/g, with a total polyphenol content of 2.83 mg GAE/g. Among all tested concentrations, 2% FM had the significantly highest OA reduction value of 34.77% ± SD ($p \leq 0.05$) and the significantly highest moisture retention (280.52 ± SD) ($p \leq 0.05$). When compared with the MS, which showed 28.44% OA, 2% FM-treated CC sample exhibited significantly lower OA (16.29% ± SD). According to the color and texture profile evaluation, there was no significant difference between FM 2% treated sample and MS (smaller $\Delta E = 3.27$) ($p > 0.05$). Overall, 2% flax mucilage can be considered an effective natural edible coating to reduce OA during deep-frying. The result suggested that increasing FM beyond 2% might reduce the OA capacity furthermore.

Keywords: *Deep frying, edible coating, oil absorption, Soxhlet extraction.*

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Color enhancement of Ceylon black tea using gamma irradiation

C.M.D.K. Chandrasekara[2*], R.M.N.P. Rathnayake[1], W.S.M. Senevirathne[2]

[1]*Sri Lanka Atomic Energy Board, Orugodawatta, Wellampitiya, Sri Lanka*
[2]*Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*

[*]*cmdkaushal97@gmail.com*

Gamma irradiation is a widely recognized food processing technology. Enhancing colour helps maintain competitiveness, meet international consumer expectations, and improve the perceived value of the tea. Very few studies have done for colour enhancement of Ceylon black tea (CBT) using gamma irradiation. A 26 freshly prepared CBT powder samples were collected from tea manufacturers in 3 main tea growing regions. Samples were irradiated at doses of 0, 5, 10, and 30 kGy by an industrial Co-60 gamma irradiator. Physicochemical properties, colour of powder and infusion (using Hunter Lab and CIE L*a*b* colour spaces), water activity (aw), and total polyphenolic content (TPPC) were measured. All measurements were duplicated. In tea powder, 30 kGy sample had significantly higher CIE a* value (1.68 ± 0.30), indicating more reddish colour compared to others ($P < 0.05$) but Hunter a value was significantly higher in 5 kGy sample ($P < 0.05$). However, both CIE b* and Hunter b values were significantly lower (indicating less yellowness) in the 30 kGy tea powder samples ($P < 0.05$). Irradiation significantly reduced the Hunter L and CIE L* values in tea infusion ($P < 0.05$), with the lowest values observed at 30 kGy. TPPC in 30 kGy sample was significantly higher (36.92 ± 13.34 mg GAE g^{-1}) than other doses in tea infusion ($P < 0.05$). Moreover, a_w significantly increased (0.49 ± 0.03) with irradiation in tea powder ($P < 0.05$). This might be due to the breakdown of complex molecules. Therefore, it is concluded that colour and TPPC were enhanced by gamma irradiation, with 30 kGy being the optimal dose for CBT.

Keywords: *Infusion, physiochemical properties, polyphenols, radiation, value addition*

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Development of a plant-based spread incorporating *Cicer arietinum* (chickpea), *Vigna radiata* (mung bean), and *Persea americana* (avocado)

J.J. Natasha[1*], K.M. Somawathie[1]

[1]*Department of Food Science and Technology, Faculty of Applied Science, Sabaragamuwa University of Sri Lanka*

[*]*jennynatasha4@gmail.com*

The demand for plant-based products is increasing among health-conscious consumers. This study aimed to develop a plant-based spread (PBS) incorporating chickpea, mung bean (MB), and avocado. Three different formulations of PBS were prepared by blending varying proportions i.e. (60, 20, 20 w/w), (50, 30, 20 w/w) and (40, 40, 20 w/w) of chickpea, MB and avocado respectively. Prepared spreads were then evaluated by 30 semi-trained panel to determine the best formulation and one most preferred spread was further analysed for its proximate composition, texture and colour using standard methods. Shelf-life parameters such as microbial analysis, pH, titratable acidity (TA), and peroxide value (PV) were determined. According to the sensory evaluation, sample prepared with 60% chickpea, 20% MB and 20% avocado was selected as the best formulation based on appearance, colour, aroma, flavour, texture, and overall acceptability. Proximate analysis of the best formulation confirmed the lower fat content (12.06±0.37 %) compared to the market available non-dairy fat spread (MANFS) (81.78±0.18%). The best formulation exhibited lower hardness (2.89±0.16 g), reduced adhesiveness (1.24±0.02 mJ), and higher cohesiveness (0.77±0.02), indicating a softer texture and better spread-ability compared to MANFS. The best PBS was significantly darker (L*=10.49±0.40) with greener tone (a*=-2.88±0.20) and less yellow (b*= 12.20±0.25) appearance. Shelf-life evaluation highlighted PBS has limited shelf-life of three weeks at 4°C storage condition with no added preservatives. During three weeks of storage, the best formulation was microbiologically safe, pH progressively decreased (5.59-6.56), TA steadily increased (0.12-0.17) and the PV was not detectable. After the third week, the PBS showed microbial spoilage (TNTC), increased TA (0.25), a drop in pH (4.96), and detectable PV (18.23) indicating lipid oxidation, reduced quality and safety. These findings support that the developed best PBS is a healthier alternative to conventional fat spreads and acceptable product for health-conscious consumers seeking plant-based options.

Keywords: *Formulations, proximate composition, sensory analysis, shelf-life, texture analysis*

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Development and evaluation of non-dairy plant based fermented beverage

R. Rinokshan[1], D.A.C.K. Dalukdeniya[1*]

[1]*Department of Food Science and Technology, Faculty of Applied Science, Sabaragamuwa University of Sri Lanka*

**choshani@appsc.sab.ac.lk*

Consumers are increasingly motivated to choose plant-based food products, with demand rising across all groups, including Gen-Z. Most fermented beverages (FBs) are dairy-based, limiting accessibility for non-dairy consumers. The objective of the study was to develop and evaluate non-dairy FB using horse-gram milk (HM) and rice milk (RM) (water-to-grain ratio, 1:1). Three formulations of FB were made by varying proportions of HM (w/w 80, 65, 50) with RM and fermented using ABT-5 probiotic culture at 37 °C for 12±1 hours. The developed FB were evaluated for overall acceptability by 30 members of semi-trained panel using a 5-point hedonic test. The selected best formulation of the plant-based FB, along with a control sample (identical formulation without the addition of probiotic culture), was analysed for probiotic viability (PV), physicochemical properties, and shelf-life in refrigerated condition (4 °C). PV was assessed using optical density measurement and viable cell count. Physicochemical properties evaluation included pH, titratable acidity (TA), and total soluble solids (TSS). Shelf-life was determined through total plate count (TPC) analysis. Sensory analysis identified that FB prepared with 80% HM and 20% RM was the most consumer-preferred sample. PV analysis demonstrated an initial count of 6.30×10^{6} CFU ml^{-1} at 0 hours; however, the counts decreased with time. Physiochemical results showed that, pH and TSS were decreased and TA was increased with the fermentation indicating the significant difference ($p< 0.05$) between the control and FB sample. TPC analysis showed that aerobic spoilage microbes increased over time, reaching unacceptable levels by day 20, indicating that refrigeration at 4 °C was the most suitable condition to extend shelf-life and PV. In conclusion, the viability of probiotics was limited by the time of consumption, and the expected shelf-life of unopened FB was approximately 10-15 days. Further evaluation under anaerobic conditions and refrigerated storage is recommended to enhance PV and improve the shelf-life.

Keywords: *Functional food, hedonic test, horse-gram milk, probiotic, rice milk*

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Changes in the antioxidant potential of *Acromitus flagellatus* (jellyfish) based gelatin after *in vitro* gastrointestinal digestion

R.A.S.N. Ranasinghe[1], W.L.I. Wijesekara[1], S.A. Senanayake[1], P.R.D. Perera[1], M.M. Pathmalal[2], R.A.U.J. Marapana[1]*

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka*
[2]*Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka*

**umarapana@sci.sjp.ac.lk*

In Sri Lankan coastal areas, frequent blooms of jellyfish *Acromitus flagellatus* have been observed in recent years, which have interfered with fisheries and aquaculture. Generally, this species is discarded as bycatch. Conversely, the use of bioactive peptides derived from various proteins such as soybean and gelatin in the formation of health-promoting foods has gained huge attention. Hence, the present study investigated the changes in the antioxidant potential of jellyfish *Acromitus flagellatus*-based gelatin, that were extracted using hot water extraction at 60°C for 8 hours (HW-JFG) and microwave-assisted extraction at 900 W, 50% power level for 3 minutes (MW-JFG), after *in vitro* gastrointestinal digestion. The antioxidant activities of different digestion stages of jellyfish-based gelatins were compared with those of analytical grade cold-water fish skin gelatin (FSG) and porcine skin gelatin (PSG). Three different antioxidant assays; 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonate) (ABTS) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activities, and ferric reducing antioxidant power were performed for undigested gelatins and after oral, gastric, and intestinal digestion stages. ANOVA revealed that antioxidant activities noticeably varied depending on the gelatin type and the digestion stage ($p < 0.05$), and significantly increased with the progress of the digestion. Intestinal digestion resulted in a remarkable increase of ABTS radical scavenging activity by 6.8, 4.8, 5.2, and 5.8 times compared to the gastric stage in HW-JFG, MW-JFG, FSG and PSG, respectively. Moreover, microwave-extracted jellyfish gelatin exhibited better antioxidant activities compared to hot water-extracted gelatin. Hence, the findings show that microwave-assisted extraction is an efficient way of producing gelatin with increased antioxidant potential within a short time. The resulting *Acromitus flagellatus*-based gelatin could be used in food and pharmaceutical industries, attributed to their health-promoting ability after ingestion. There is a future potential for the purification of peptides with high antioxidant potential from gelatin that was derived from jellyfish.

Keywords: *Bioactivity, free radical scavenging, microwave extraction, proteins, reducing ability*

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Awareness and demand for the different types and brands of tea among consumers in central province of Sri Lanka

A.M.P. Alahakoon[1*], H.A.N.H. Hapuarachchi[1], T. Sajipiratha[1], W.S.M. Senevirathne[1]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka*

**pavialahakoon3@gmail.com*

Sri Lanka is a major tea producer and exporter, with its central province being a key region for producing high-quality Ceylon tea. Understanding consumer awareness and demand for tea in this region is important to identify strategies to compete effectively in an increasingly diversified and competitive beverage market. The objective of this study was to evaluate the awareness and demand for the different types and brands of tea among consumers in the central province. A cross-sectional survey employing a self-administered, anonymous web-based structured questionnaire, covering demographic information, tea consumption habits, preferences, purchasing behaviour, and factors influencing brand choices was conducted. Data was collected from 386 individuals across the central province and analyzed using Minitab (version 17) software. Associations between consumer awareness, demand, and demographic factors were examined using Chi-square tests. Correlations between demographic variables, awareness and demand were explored using cross-tabulation analysis. The study revealed a strong dominance of black tea (100% awareness, 83.3% demand), followed by green tea (84% awareness, 19.5% demand). Demographic factors like education level ($\chi^2 = 66.30$, $p < 0.01$) and sector ($\chi^2 = 66.39$, $p < 0.01$) significantly influenced awareness on tea types, while income level ($\chi^2 = 85.20$, $p < 0.01$) influenced brand purchasing decisions. A strong correlation ($r = 0.76$) existed between awareness and demand for tea types, while a moderate correlation ($r = 0.65$) existed for brands. Family/ friends recommendations primarily drove tea type awareness, while social media and television/ radio advertisements influenced brand awareness. Price was the most significant factor influencing purchasing decisions across all tea types and brands, indicating a price-sensitive market. The study provided valuable insights for tea manufacturers to tailor targeted marketing strategies leveraging social influence, digital engagement, and competitive pricing to expand consumer reach.

Keywords: *Ceylon tea, consumer behaviour, influential factors, tea consumption*

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Development and characterization of biodegradable food packaging based on *Manihot esculenta* (cassava) starch enriched with antioxidant properties

M.W. Nagahapitiya[1*], K.M.G.K. Pamunuwa[1]

[1]*Department of Horticulture and Landscape gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka*

[*]*nagahapitiyaminoli89@gmail.com*

The extensive usage of plastics which contribute approximately 40% of global packaging material usage due to their versatility, durability, and cost-effectiveness, causes significant environmental impact due to non-biodegradability. In recent times, the development of biodegradable packaging material has gained significant attention. The aim of this study was to develop and characterize cassava starch (CS)-based films incorporated with jackfruit (*Artocarpus heterophyllus*) leaf extract (JLE) as a biodegradable solution which has not been incorporated in the previous literature. Starch extraction was done using wet milling. The solution casting method was used to prepare CS films incorporating glycerol and pectin to improve the flexibility. JLE was added at different concentrations (0% (T1), 1% (T2), 2% (T3), and 3% (T4) w/w of starch) to give antioxidant activity to the films. The prepared films were assessed for their physicochemical properties, including colour attributes L^* (lightness), a^* (redness), b^* (yellowness), ΔE (colour difference), opacity, thickness, solubility, and swelling degree. Additionally, antioxidant capacity was measured through the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay, total phenolic content (TPC) was evaluated using the folin ciocalteu reagent. The thickness of the films showed no significant difference ($p > 0.05$). The average thickness ranged between 0.161 and 0.165 mm. T1 showed the lowest opacity value (0.811 Abs600nm/mm), while the value gradually increased with increasing JLE content. As expected, the L^* values decreased, while a^*, b^*, and ΔE values increased on increasing the JLE concentration in the films. As expected, the TPC of the CS film with 3% of JLE showed the highest value (79.07 mg gallic acid/g). Also, the antioxidant capacity of the films increased significantly on increasing the JLE content. To conclude, treatment 4 (3% JLE) demonstrated best performance, exhibiting the highest antioxidant capacity (38.43%) while maintaining satisfactory film characteristics except solubility which has to be improved.

Keywords: *Antioxidant capacity, film characterization, jackfruit leaf extract, opacity, phenolic content*

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Effect of salicylic acid foliar application on the bioactive properties of *Osbeckia octandra* and *Flueggea leucopyrus*

F.S. Anas[1], K.D.C. Pamalka[1], G.S.G. Liyanage[1*]

[1]*Faculty of Life and Medical Sciences, BMS Campus, Colombo 06, Sri Lanka*

[*]*geethika.l@bms.ac.lk*

The exogenous application of Salicylic Acid (SA) has been demonstrated to enhance the synthesis of phenolics, flavonoids, and other bioactive compounds of therapeutic significance. However, in the context of two indigenous medicinal plants *Flueggea leucopyrus* and *Osbeckia octandra*, there is a lack of scientific data about the impact of elicitor therapies on their bioactivity. This study aimed to assess the effects of foliar SA application on growth parameters, chlorophyll content, primary metabolite composition and antibacterial activity in the two selected medicinal plants. A p-value <0.05 was considered as statistically significant. Salicylic acid concentrations of 0.5, 1.0, 1.5 mM and water (control) were administered to *F. leucopyrus* and *O. octandra* plants (n = 10 per treatment) through foliar spray once daily over an eight-week period. Studied SA concentrations did not display a significant effect on plant height in both plant species. A significantly high chlorophyll content was observed in both *F. leucopyrus* (20.38 µg/ml) and *O. octandra* (12.28 µg/ml) in the 0.5 mM SA treated plants compared to other groups. The 1.5 mM SA treatment resulted in the highest total phenolic (40.92 mg Gallic Acid Equivalents (GAE)/g) and flavonoid (5.7 µg Quercetin Equivalents (QE)/g) contents in *F. leucopyrus*, with a significant increase observed in phenolics. The 0.5 mM SA treatment produced the highest total phenolic (6.37 mg GAE/g) and flavonoid (59.77 mg QE/g) contents in *O. octandra*, with a significant increase observed in flavonoids. *Staphylococcus aureus* was most susceptible to the control group of *O. octandra* (20.5 mm inhibition zone) and showed no response to *F. leucopyrus* under any treatment. This study demonstrated that foliar SA application influences key biochemical traits in *F. leucopyrus* and *O. octandra* in a dose and species dependent manner. Therefore, it is essential to optimize the SA concentration in future studies to determine the optimal levels that effectively promote plant growth and enhance phytochemical content in both species.

Keywords: *Antibacterial activity, bioactive compounds, elicitors, medicinal plants*

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Development and evaluation of rusk fortified with *Moringa oleifera* leaf powder and flakes: nutritional, sensory, physicochemical and shelf-life assessment

K.D.K. Sewwandi[1*], C. Ranasinghe[2], N.M. Wijesundara[3]

[1]*Department of Animal Science, Uva Wellassa University, Badulla, Sri Lanka*
[2]*Diana Trading Co. (Pvt) Ltd, Weragama, Kaikawala, Matale, Sri Lanka*
[3]*Department of Food Science and Technology, Uva Wellassa University, Badulla, Sri Lanka*

**99koshila@gmail.com*

The fortification of bakery products with functional ingredients, such as *Moringa oleifera*, presents a promising approach to enhance their nutritional and health-promoting properties. The objective of this study was to evaluate the proximate composition, shelf life, and microbial quality of rusk supplemented with dried moringa leaf powder and flakes. The fortification was done using equal proportions (50:50) of dried moringa leaf powder and flakes for each incorporation level. The optimized formulation, containing 0.74% dried moringa leaf powder and flakes, was previously selected based on sensory evaluation among incorporation levels of 0, 0.74, 0.87, 0.99, and 1.12%, and was subjected to further physicochemical, and microbiological analysis. Proximate composition revealed that the moringa-fortified rusk contained 2.01 ± 0.00 moisture (%), 15.13 ± 0.00 crude protein (%), 12.20 ± 0.11 crude fat (%), 0.43 ± 0.00 crude fiber (%), 68.19 ± 0.11 carbohydrate (%), and 2.06 ± 0.00 ash (%), contributing to an energy value of 443.02 ± 0.56 (kcal/100 g). There was a significant difference in proximate composition between 0.74% dried moringa leaf powder and flakes incorporated into the rusk and the control sample. These results confirmed nutritional enhancement, especially in terms of protein and fibre content. Shelf-life evaluation was conducted for both control and selected rusks over 85 days at room temperature using 30 µm biaxially oriented polypropylene/25 µm metalized cast polypropylene packaging. Significant variations ($p < 0.05$) in moisture, free fatty acid, and pH were observed during storage; however, values remained within acceptable limits. Microbial analysis revealed 1.0602 log cfu/g of total plate count after 30 days in both control and the rusk incorporated with 0.74% dried moringa leaf powder and flakes, whereas yeast and mold counts were absent throughout the 85 days, indicating microbial stability of the product. The study concludes that moringa-fortified rusk not only improves the nutritional profile but also retains acceptable shelf stability and microbial safety during extended storage.

Keywords: *Moringa, proximate, rusk, sensory, shelf-life*

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Design & development of ultrasonic bat deterrent system for sustainable fruit farming

T.V. Anjana[1*], R.P.R.K. Amarasinghe[1], W.M.D. Priyadarshani[1]

[1]*Sri Lanka Technology Campus, Meepe, Sri Lanka*

[*]*vidushianjana0@gmail.com*

In countries which are situated in tropical and subtropical regions (such as India, Sri Lanka, etc.) fruit orchards which cultivate fruits such as Mango, Guava, Banana, Lychee, fig attract frugivore bats in harvest. According to the survey conducted in this research many Sri Lankan small scale to industrial level fruit orchards have faced this problem and farmers have lost minimum Rs. 30,000 worth harvest per season. Farmers cannot eliminate them because they are endangered species and helps agricultural activities such as pollination. This Design project focuses on designing a bat deterrent system which is expected to turn on automatically at night time and emit an ultrasonic acoustic frequency which bats are sensitive to. The repellent mechanism of the frequency will continue until the LDR sensor detects day time as bats are nocturnal species. From the literature review it has been found the echolocation frequency of frugivore bats to be in range of 20 to 50kHz. Both echolocating and non-echolocating bats were found to be sensitive to up mentioned frequency range. To avoid habituation an amplifier was also added to the device to regulate the frequency within the range of 20-50kHz. the device was designed to be powered by a solar panel and a rechargeable lead ion battery (approximately 9 devices can be powered by using one rechargeable battery). The device is powered by solar power. The device, placed 3m below the tree canopy, covers an area with a 4.058 m^2. Maximum coverage distance is 5m. The device has been tested a few times in a small-scale banana orchard. According to those trials it was found that the frequency range between 30-40 kHz is the most accurate frequency range to repel bats. Future research will concentrate on assessing its environmental impact, range, and efficacy.

Keywords: *Echolocation, frequency, frugivore, habituation*

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Sorption efficiency of calcium ions by green leafy vegetables

C.S. Hiddallaarachchi[1], U.K. Jayasundara[1*]

[1]*College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya 10100, Sri Lanka;*
[2]*Department of Chemistry, University of Maine at Presque Isle, Presque Isle, ME USA 04769*

[*]*udaya.jayasundara@maine.edu*

Calcium, which primarily exists as calcium ion (Ca^{2+}), is the most abundant in the human body and is vital for multiple physiological functions. However, the human body cannot produce calcium on its own. Hence, it must be supplied through calcium-rich foods. When green leafy vegetables (GLVs) are consumed along with such foods, the oxalate ions ($C_2O_4^{2-}$) present in GLVs combine with the Ca^{2+} and form calcium oxalate (CaC_2O_4), which is an insoluble precipitate that causes the kidney stones. In this study, the calcium sorption efficiency of the GLVs was evaluated using *Ipomoea aquatica* (Kankung), *Alternanthera sessilis* (Mukunuwann), *Asparagus racemosus* (Hathawariya), *Sesbania grandiflora* (Kathurumurunga), and *Centella asiatica* (Gotukola) by varying the Ca^{2+} concentration and contact time. A 10 g portion from each GLV was soaked in 25 mL of standard calcium solutions (20, 40, 60, 80, and 100 ppm) separately for 1 and 2 hours. In the kinetic study, the GLVs were soaked in calcium-rich foods such as milk, yoghurt drink, tofu, curd, and salmon water, with the contact time varied. Prepared samples of each were used to measure Ca^{2+} concentrations through atomic absorption spectroscopy. The sorption efficiency of GLV increased to a certain level with increasing Ca^{2+} concentration and contact time. *Asparagus* increases up to only 40 ppm, and *Alternanthera* increases up to 60 ppm in both one-hour and two-hour sorption. The kinetic study showed that GLVs bind Ca^{2+} when consumed together. The Ca^{2+} concentrations of *Alternanthera* and *Centella* were increased, and the Ca^{2+} concentrations of calcium-rich foods were decreased with time. The variation is different for each GLV and calcium-rich food. Sometimes reached after 15 minutes, but it is again unstable after two. The equilibrium is reached after 15 minutes. Still, it is unstable again after 2 hours, while the salmon water shows the opposite behaviour. This study reveals that consumption of GLVs and calcium-rich foods together can negatively affect calcium absorption in the body by forming (CaC_2O_4). To relate this to the gastric environment, it is necessary to study the pH to simulate the conditions of the human stomach.

Keywords: *Calcium-rich foods, concentration, consumption, oxalates, time*

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Evaluating knowledge, attitude, and practices regarding low glycaemic index carbohydrate-based foods among educated working women in urban Sri Lanka

J.P.C.V.T. Jayasinghe[1*], G.M. Somaratne[2], U. Walallawita[3], D. Gunasekara[4]

[1]*Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka*
[2]*Department of Food Science and Technology, University of Peradeniya, Sri Lanka*
[3]*College of Health, Massey University, New Zealand*
[4]*Department of Research and Development, CIC Dairies, Dambulla, Sri Lanka*

**thamashijayasinghe123@gmail.com*

Low glycaemic index (GI) foods are essential in managing blood glucose levels and reducing the risk of non-communicable diseases (NCDs), particularly diabetes. Despite their benefits, awareness and practical adoption of such dietary practices remain limited among urban educated working women in Sri Lanka. This study evaluated the knowledge, attitudes, and dietary practices (KAP) related to low GI foods and the potential of a social media-based awareness intervention. A descriptive cross-sectional study was conducted among 758 participants selected through stratified sampling from major urban regions across the country. Data were collected using a validated questionnaire disseminated via Email, Facebook, and WhatsApp. Findings revealed that although participants demonstrated positive attitudes (mean score: 66/80), their knowledge (5/10) and dietary practices (26/48) were relatively low. As the data were non-normally distributed (Kolmogorov-Smirnov test, $p < 0.05$), non-parametric tests were applied. Spearman correlation analysis indicated a moderate positive correlation between knowledge and attitude ($\rho = 0.382$, $p < 0.001$), and a weaker but significant correlation between knowledge and dietary practices ($\rho = 0.254$, $p < 0.001$). This suggests that while knowledge fosters favourable attitudes, it does not consistently lead to behaviour change. Barriers such as limited availability of low GI foods, higher cost, lack of time, and established eating habits may hinder practical application. Younger women (18–30 years) and those with postgraduate qualifications had significantly higher knowledge scores. Attitudes and practices were positively associated with income and education levels. Given that urban working women play a key role in family food decisions, these findings underscore the need for accessible, targeted digital nutrition education strategies to enhance dietary literacy and promote healthier food choices, thereby helping to mitigate the rising burden of diet-related NCDs in Sri Lanka.

Keywords: *Diabetes, glycaemic, knowledge, women*

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Ozonated water as an eco-friendly approach to improve seed germination in *Vigna radiata* and *Phaseolus vulgaris*

M.M.T. Yuwanika[1], D.M.H.S.K. Nadungamuwa[1], R.M.C.S. Ratnayake[1*]

[1]*University of Kelaniya, Sri Lanka*

[*]*ratna@kln.ac.lk*

Vigna radiata (mung bean) and *Phaseolus vulgaris* (common bean) are common crops cultivated mainly for their edible seeds and young sprouts. However, seed germination and plant growth are often hinder by biotic and abiotic stresses, result in poor germination and reduced crop yields. Ozonated water offers novel and eco-friendly option by mildly stressing seeds to activate their defense and metabolic processes. This study focused on examining the effect of water ozonated in different time periods to identify the most effective ozonation period on seed germination of the two species. Healthy, surface-sterilized *V. radiata* and *P. vulgaris* seeds (120) were immersed in ozonated water for 30 minutes. Treatments consisted of distilled water ozonated for 0 (control), 5, 10, and 15 minutes. Treated seeds were incubated at room temperature on moistened filter paper in petri dishes for 6 days following completely randomized design with three replicates. Seed germination parameters: Mean Germination Rate (MGR), Mean Germination Time (MGT), Mean Germination Index (MGI), and Mean Coefficient of Velocity of Germination (MCVG) were calculated. Data were analyzed using one-way ANOVA at $\alpha = 0.05$, followed by Tukey's pairwise comparison using "R" statistical software. Ozonated water significantly increased mean germination index, and coefficient of velocity of germination, along with reduction in mean germination time compared to the control in both species. *V. radiata* seeds treated with 15 minutes of ozonated water showed the highest MGR (100%), MGI (24.17± 0.58) and MCVG (96.97± 5.25) with the lowest MGT (1.03 ± 0.06). Similarly, *P. vulgaris* recorded the highest MGR ($83.33^a \pm 5.77\%$) and MGI ($11.81^a \pm 0.42$) while MCVG and MGT were similar across ozonated treatments. Among these treatments, 15 minutes ozonated water treatment is recommended as the most effective method to enhance seed germination in both *V. radiata* and *P. vulgaris in vitro.* The long-term effects of ozonated water treatment under field conditions will be determined in future studies.

Keywords: *Abiotic stress, eco-friendly treatment, ozonated water, plant growth, seed germination*

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Assessment of soil nutrients availability across selected land use types in the *Katupotha* tank cascade system, Mihintale, Sri Lanka

W.D.U. Premarathna[1,2], G.A.D. Perera[3], S.B. Karunaratne[4], R.R. Ratnayake[1*]

[1]*National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka*
[4]*CSIRO Agriculture and Food, Butler Laboratory, Black Mountain, Australia*

[*]*renuka.ra@nifs.ac.lk*

The knowledge regarding the variation in soil nutrient availability across different land use types in dry zone landscapes is essential for evaluating soil fertility and ensuring sustainable land management. This study aimed to assess the current status of available forms of nitrogen and phosphorus, in soils collected from forest, shifting cultivation lands, and paddy fields within the *Katupotha* Tank Cascade System in Mihintale (KTCS), Sri Lanka. A total of 100 surface soil samples (0–15 cm depth) were collected using the stratified random sampling; 16 from shifting cultivation (SC), 54 from paddy (PF), and 30 from forest lands (FL). Soil pH, electrical conductivity (EC), and available macronutrients (nitrate, ammonium, and phosphate) were analysed using standard methods. The results indicated that PF recorded the highest soil pH and EC values (7.40 and 66.88 µS cm^{-1}), followed by FL (6.97 and 37.26 µS cm^{-1}), and SC (6.85 and 32.10 µS cm^{-1}). Ammonium concentrations were the highest in PF (38.90 µg g^{-1}), followed by SC (23.97 µg g^{-1}) and FL (15.51 µg g^{-1}). Conversely, nitrate levels were the greatest in SC (12.56 µg g^{-1}), followed by FL (8.90 µg g^{-1}) and PF (1.92 µg g^{-1}) showing the lowest value. Phosphate content was also high in SC (5.01 µg g^{-1}), while FL and PF exhibited lower concentrations of 2.11 µg $g^{-1}$and 1.79 µg g^{-1}, respectively. These findings highlight the significant influence of land use on the distribution of available macronutrients in soils of KTCS. High ammonium contents in PF reflects its retention under flooded, anaerobic conditions, while higher nitrate and phosphate in SC lands result from increased anthropogenic nutrient inputs and continuous cultivation practices. FL show low nutrients due to limited input and possible losses from steep-slope erosion and leaching. These findings are vital for sustainable soil management practices in the dry zone agroecosystems, as they provide baseline data for developing nutrient management strategies to enhance agricultural sustainability.

Keywords: *Forest lands, paddy fields, selected macronutrients, shifting cultivation, sustainable land management*

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Dietary patterns of rural communities in Minuwangoda divisional secretariat area, Sri Lanka; A pilot study

J.M.C.U. Karunarathna[1], P.G.S.M. De Silva[2], W.M.T. Madhujith[1], A.B.G. Silva[3*]

[1]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka*
[2]*Department of Electron Microscopy, Medical Research Institute, Colombo 08, Sri Lanka*
[3]*Department of Nutrition, Medical Research Institute, Colombo 08, Sri Lanka*

[*]*buddhikagayani@yahoo.com*

The evolving Sri Lankan traditional food system varies among communities and poses health challenges through malnutrition and non-communicable diseases, with further dietary changes driven by the pandemic and economic crisis. This study examined the dietary habits in the Minuwangoda Divisional Secretariat area, focusing on energy intake, nutritional adequacy, and changes due to economic challenges. A cross-sectional survey of 54 randomly selected families was conducted using an interviewer-administered questionnaire and a 24-h diet recall method. IBM SPSS 23.0 was used to dissect data. Of the total (n=177), (56.5 %) participants were aged between 18 and 60, 41.81% had secondary education and (19.8%) participants monthly income between 20,000- 50,000 LKR. Moreover, 28.9% participants were reported to have long-term illnesses. Among them, (67.8%) were Buddhists, 19.2% were Catholics and 13.0% were Muslims. Their dietary restrictions were shaped by personal preferences (50.9%) or religious beliefs (28.2%). Findings showed that mean energy intake (2025 kcal) exceeded the Daily Recommended Dietary Allowance for energy for children (530 kcal – 1920 kcal), adults (1710 kcal- 1890 kcal) and people above 70 years (1620 kcal- 1980 kcal). All the selected families used coconut for cooking, used in scraped form (50 families) rather than powdered form (4 families). The daily intake of protein, carbohydrate and total dietary fiber were 67.3 g, 336.2 g and 24.9 g. The economic downturn significantly ($P < 0.05$) altered dietary patterns. Of the respondents, 97.0% had less expenditure on diet and significantly different ($P < 0.05$) in quantity and frequency of consumption of meat, fish and leafy vegetables across all ethnic groups. The study expressed a nutrition transition of that area (excess calories and poor diet diversity)- shaped by economic crisis and the pandemic situation.

Keywords: *Economic downturn, energy intake, malnutrition, nutritional adequacy*

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Soil quality dynamics in a traditional tank ecosystem: A case study of *Katupotha* tank in Anuradhapura, Sri Lanka

R.M.M.K.H. Ranasinghe[1], W.D.U. Premarathna[1,2], G.A.D. Perera[3], R.R. Ratnayake[1*]

[1]*National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka*

**renuka.ra@nifs.ac.lk*

Traditional tank cascade systems in Sri Lanka play a crucial role in maintaining ecological stability and supporting agricultural productivity, while significantly influencing soil quality dynamics in the dry zone. play a crucial role in soil quality dynamics in the dry zone. Tanks integrate traditional hydraulic engineering and ecosystem-based approaches that support paddy cultivation while influencing soil moisture retention, nutrient cycling, and overall soil health. This study aims to assess the key soil quality parameters, including pH, electrical conductivity (EC), moisture content, bulk density, and soil available macronutrients (nitrate, ammonium, and phosphate) in the surrounding vegetation near *Katupotha* Tank, located in Anuradhapura, Sri Lanka. A total of 30 soil samples were collected from surface (0-15 cm) and sub-surface (15-30 cm) soil layers, and were tested using standard methods. Descriptive statistics indicated surface soil exhibited lower pH (7.23), higher moisture content (25.24%), and lower bulk density (0.79 g cm^{-3}) compared to subsurface soils, which had higher pH (7.63), lower moisture content (18.52%), and higher bulk density (0.96 g cm^{-3}). Electrical conductivity was highly variable across both layers, with a slightly higher value in the surface layer (0.90 µS cm^{-1}). Paired t-test results revealed that several soil parameters differed significantly between surface and subsurface layers. Significant differences were observed in pH ($t = -3.16$, $p = 0.007$), moisture content ($t = 4.98$, $p = 0.001$), bulk density ($t = -2.15$, $p = 0.050$), available nitrate ($t = -2.63$, $p = 0.021$), and available ammonium ($t = 3.98$, $p = 0.001$). These indicate the presence of strong vertical variation in both chemical and physical soil properties. However, no statistically significant differences were found for EC ($t = -0.18$, $p = 0.086$) and available phosphate content ($t = 1.52$, $p = 0.153$). These results highlight the importance of considering soil depth in evaluating soil health, fertility, and nutrient management strategies in the dry zone tank ecosystems.

Keywords: *Nutrient cycling, soil health, soil quality parameters, sustainable land management, tank cascade system*

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An analysis of the current status of extension and advisory services in the cinnamon industry of Sri Lanka's southern province

D.M.C. Jayamini[1*], K.N.N. Silva[2], V. Kanwal[3]

[1]*Faculty of Graduate Studies, University of Ruhuna, Matara, Sri Lanka*
[2]*Department of Agricultural Economics and Agribusiness, Faculty of Agriculture, University of Ruhuna, Sri Lanka*
[3]*Punjab Agricultural University, Ludhiana, India*

* *jayaminidissanayaka2@gmail.com*

Ceylon cinnamon (*Cinnamomum zeylanicum)* is one of the commercially important spice crops in the world due to its unique aroma, flavour, medicinal properties, and significant contribution to the Sri Lankan economy. Moreover, Extension and advisory service plays a vital role to strengthening productivity, ensuring quality, and promoting sustainability in the cinnamon industry. Nevertheless, there is a lack of sufficient research on extension and advisory services in the cinnamon industry. Therefore, this study aimed to identify the existing situation of extension and advisory services in the Sri Lankan cinnamon industry to enhance the productivity of the cinnamon industry. The study was conducted in the Southern Province, where primary data were collected from 350 farmers and peelers using a snowball sampling technique between January 21 to March 31,2025. Data were analysed using SPSS software and Friedman test which facilitate the systematic processing and interpretation of gathered quantitative data. According to the results, 89.7% of the sample reported that they had not received proper extension and advisory services while only 9.4% of the sample indicated that they received such services in the cinnamon industry within the past two years. According to the Friedman test results, among those who received services, the majority obtained information on pest and disease control from government extension officers (Mean rank 2.34) and 67.6 % of participants received group training sessions as the main method of delivering extension and advisory services. Moreover, 97.4% of the sample did not use Department of Export Agriculture (DEA) and Export Development Board (EDB) websites to gain more information related to the cinnamon industry. Although 69.7% of the sample revealed that dissatisfaction with the current extension and advisory service in the cinnamon industry. Therefore, this study revealed that it is essential to further strengthen extension and advisory services related to cinnamon industry.

Keywords: *Ceylon cinnamon, cinnamon farmers, cinnamon peelers, knowledge dissemination*

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Optimization of soluble protein content in wheat-based (*Triticum aestivum*) pasta fortified with *Moringa oleifera* leaf powder and *Glycine max* flour

H.D. Saubhagya[1], H. Nawagamuwa[2], N. Withanage[2], W.L.I. Wijesekara[1*]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*
[2]*Department of Statistics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

[*]*isuruw@sci.sjp.ac.lk*

Plant protein fortification of staple foods is a sustainable approach to enhance nutritional and functional quality. This study evaluated the effect of incorporating 0% (control), 5%, 10% and 15% of *Moringa oleifera* and *Glycine max* individually into *Triticum aestivum* all-purpose wheat flour pasta, on the soluble protein content. *Moringa oleifera* leaves were oven-dried at 45±2 °C and milled into fine powder, while *Glycine max* beans were germinated, dehulled, dried at 45±2 °C, and ground into fine flour before incorporation. Soluble proteins were extracted using distilled water (pH 7.0) and quantified using the Bradford assay, with Bovine Serum Albumin (BSA) as the standard. Absorbance was measured at 595 nm, and results were expressed as mg BSAE/g sample. Data were analysed by one-way ANOVA ($p < 0.05$). Both *Moringa oleifera* and *Glycine max* fortification significantly ($p<0.05$) increased soluble protein content compared to the control (12.32 ± 0.08 mg BSAE/g). In *Moringa*-fortified pasta, values increased to 25.73 ± 1.46, 28.41 ± 0.79, and 24.04 ± 0.77 mg BSAE/g at 5%, 10%, and 15%, respectively. *Glycine max*-fortified pasta followed a similar trend (25.90 ± 0.84, 29.39 ± 1.05, and 25.04 ± 0.95 mg BSAE/g). The 10% inclusion showed a statistically higher soluble protein content ($p < 0.05$) than the control and 5%, while the decline at 15% was likely due to protein aggregation or matrix saturation. No significant difference ($p > 0.05$) was observed between 10% *Moringa* and 10% *Glycine max*. The findings indicate that 10% fortification with either *Moringa oleifera* leaf powder or *Glycine max* flour optimizes soluble protein enrichment in wheat-based pasta. However, as protein quality also depends on amino acid composition and digestibility, further in-vitro digestibility and sensory evaluations are recommended to support nutritional and consumer acceptance claims.

Keywords: *Bioavailability, digestibility, fortification, nutritional enrichment*

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Innovative *in-vitro* propagation of *Zingiber officinale* (ginger) local variety "Siddi" for sustainable commercial cultivation and biodiversity conservation

W.M.A.C. Premasiri[1], P. Kulasingha[1], D.L.C.K. Fonseka[1*]

[1]*Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Sri Lanka*

**dlckumari@crop.ruh.ac.lk*

Zingiber officinale (ginger) is a highly valuable medicinal plant that is in high demand due to the limitations in conventional propagation. This study focuses on the in vitro propagation of *Zingiber officinale*, local variety "Siddi," which has significant medicinal and economic value offering a scalable solution for high-quality production worldwide. Rhizomes were initially kept in sealed plastic cups on fungicide-sprayed tissue paper to reduce contamination. More than eight buds emerged from each rhizome at one time and could be reused. Rhizome buds, used as explants, were surface sterilized using 10% and 15% Clorox for 10- and 15-minutes exposure times. Non-contaminated and survived buds were subcultured in the second experiment on Murashige and Skoog (MS) medium supplemented with BAP (1.5, 2.0, and 2.5 mg L^{-1}) and NAA (0.5 mg L^{-1}) to induce shooting and rooting in a completely randomized design. Statistical analysis was conducted using the SAS computer package, following ANOVA after data transformation, and mean separation was performed using Duncan's Multiple Range Test (DMRT). Among 168 replicates, the most effective sterilization treatment was 10% Clorox for 10 minutes, which resulted in 71% sterilized cultures, and the results were statistically significant ($F_{3, 164} = 28.73$, $p = 0.0001$). Among the hormone treatments, the best was 2.0 mg L^{-1} BAP + 0.5 mg L^{-1} NAA, which produced an average of 7 shoots (7–8 cm height) and 8–9 roots (9–10 cm length) within 8 weeks. Results were statistically significant ($F_{2, 165} = 31.58$, $p = 0.00049$). 10% Clorox for 10 minutes' sterilization treatment with 2.0 mg L^{-1} BAP + 0.5 mg L^{-1} NAA hormone treatment ensures optimal sterilization and minimal hormone concentrations compared to previous research. The key advantage of this innovation is that one rhizome bud can produce more than 40 *in vitro* plantlets along with a sustainable pathway.

Keywords: *In-vitro, rhizome, rooting, shooting, sterilization*

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Enabling the circular economy through social systems: Evidence from small and medium-scale agri-food enterprises in the North Western Province of Sri Lanka

D.D.Y.T. Dangalla[1*], P.C. Abeysiriwardana[2], U.K. Jayasinghe-Mudalige[1], I.V. Kuruppu[1], W.A.S. Lakmali[1], M. Udugama[1], N.W.B.A.L. Udayanga[1]

[1]*Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Sri Lanka*
[2]*Ministry of Science and Technology, Sethsiripaya Stage 1, Battaramulla, Sri Lanka*

[*]*yemodyatharushi@gmail.com*

Enabling the circular economy (CE) through targeted practices has been considered as an essential part in the process of sustainable development, particularly when working on resource-intensive sectors such as the agri-food. Taking that into account, this study examines empirically how the incentives generated through 'social systems', namely: Market-based, Regulatory, and Judicial processes, influence the adoption of CE practices among small and medium-sized enterprises (SMEs) registered with the Provincial Environmental Authority of the North Western Province in Sri Lanka. The primary data gathered from SMEs (n=50) by way of a semi-structured questionnaire covering 20 CE practices, which were categorized to reflect five key phases, including: Take, Make, Use, Distribute, and Recover, and the multiple indicators for each incentive: cost, revenue, existing and anticipated regulations, and liability laws, measured on Likert scales. The outcome of the analysis brings to light that nearly half of the SMEs exhibit a 'High' level of CE adoption, while others show a 'Moderate' or 'Low' level, highlighting the varying impact of social system incentives. An Incentive Index was developed by dividing the aggregated scores by the maximum potential score and normalizing the results. The Measurement Model displayed an acceptable level of 'internal consistency' and 'scale-reliability'; further analysis was supported by Multiple Linear Regression techniques using IBM SPSS. Among the tested variables, only existing government regulation showed a statistically significant impact on CE adoption ($\beta = 0.541$, $p = 0.001$), underscoring the dominant role of legal compliance. Other factors, including cost, sales, and revenue, anticipated government regulation, and liability laws, did not yield significant influence ($p > 0.05$). Furthermore, the findings warrant a larger sample to ensure validation and to capture contextual insights that can inform targeted strategies, particularly those that reinforce legal compliance, for broader CE adoption in agri-food SMEs.

Keywords: *Eco-innovation, environmental stewardship, green transition, institutional theory, meso and micro enterprises*

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Development and quality evaluation of puffed snack from the mixture of palmyrah (*Borassus flabellifer*) tuber and haustorium flours

C.M.M. Insaf[1*], K.M. Somawathie[1], B. Anuluxshy[1], V.S. Kapil[1]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*
[2]*Palmyrah Research Institute, Kaithady, Jaffna, Sri Lanka*

[*]*cmminsaf.18@gmail.com*

Palmyrah products are traditionally developed using tuber flour; however, their widespread application is limited due to the natural bitterness imparted by flabelliferins. While debittering improves sensory properties, it often results in reduced nutritional content. This study aimed to overcome these limitations by incorporating palmyrah haustorium a naturally sweet, nutrient-rich component of the germinated seed, alongside debittered tuber flour to develop a highly nutritious, ready to eat palmyrah based puffed snack. Prepared raw haustorium flour and debittered tuber flour were subjected into functional and physiochemical analysis. Results showed that haustorium flour have superior oil holding capacity, water holding capacity, total phenolic content (129.23± 0.002 mg GAE/100g) and 2,2-Diphenyl-1-picrylhydrazyl radical scavenging assay-IC_{50} = 27.27± 0.137 ppm) compared to debittered tuber flour. Five formulations were prepared, varying in haustorium flour content. The optimized formulation containing 15% haustorium flour (T2) was identified as the best treatment based on sensory evaluation. This selected snack demonstrated improved nutritional composition with higher protein (8.58±0.24%), calcium (168.97±2.87 mg/100g), magnesium (101.81±1.77 mg/100g), total phenolic content (139.41±0.001 mg GAE/100g), and 2,2-diphenyl-1-picrylhydrazyl radical scavenging activity assay-IC_{50} = 34.09±0.046 ppm compared to the control. The selected snack treatment shows increment in expansion ratio and decrement in hardness and fructurability ($p < 0.05$). Additionally, it exhibited higher fiber (7.199±0.109 mg/100g) and lower sodium (236.73±5.78 mg/100g) than the market samples. Moreover, the flabelliferin content was effectively reduced to 0.86±0.007 g/kg in the selected snack treatment. The product maintained excellent shelf stability over 28 days, with moisture content remaining below 3.14 %, no detectable peroxide values, and microbial counts well within safe limits. This novel gluten free snack showcase potential of palmyrah as a functional ingredient in developing culturally rooted, health oriented food product.

Keywords: *Healthy alternative, nutrition, value addition*

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Development of taro (*Colocasia esculent)* root spice incorporated spread and analysis of its biochemical properties

C.M.M. Insaf[1*], J.W.A. Sajiwanie[1]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*

[*]*cmminsaf.18@gmail.com*

Taro is a largely cultivated, readily available and locally grown crop in Sri Lanka. This study aimed to develop a taro root spice-incorporated spread, a novel plant-based food product addressing nutritional diversity and convenience. This research followed identifying an optimal formulation using sensory evaluations and analyzing the final product's biochemical, physicochemical, and shelf-life properties. Three formulations of taro spice spreads were developed by varying taro paste and coconut oil content. The most acceptable formulation, determined through a five-point hedonic sensory test, exhibited enhanced taste, texture, and spreadability. Biochemical properties of most acceptable taro spread formulation revealed a moisture content of 46.51 ± 0.03 %, crude fiber of 24.71 ± 0.18 %, crude fat of 6.51 ± 0.02 %, and ash content of 2.31 ± 0.15 %. Physicochemical analyses indicated improved texture and viscosity, while color analysis highlighted enhanced brightness and appealing reddish-yellow hues with values of L^* (14.75 ± 0.12), a^* (9.18 ± 0.14) and b^* (40.82 ± 0.18). The product maintained microbiological stability and sensory acceptability throughout shelf-life period under proper storage conditions. Furthermore, Processing reduced anti-nutritional oxalates by 74.96%, addressing concerns about oxalate toxicity in raw taro. Inclusion of natural acidulants and preservatives enhanced safety and longevity, adhering to Sri Lankan Standards (SLS) for processed foods. The taro spread represents a cost-effective, nutritious, and allergen-free alternative to existing spreads, catering to health-conscious consumers and individuals with dietary restrictions. By transforming an underutilized crop into a functional, ready-to-serve product, this research underscores taro's potential to promote food security and sustainable dietary practices in Sri Lanka and beyond.

Keywords: *Functional food, nutritional diversity, plant-based product*

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Antimicrobial and bio-preservative potential of indigenous *Lactobacillus* spp. in tender coconut water against foodborne pathogens

D. Pavalakumar[1,2], L.J.S. Undugoda[1*], P.M. Manage[2,3], R.N. Nugara[1], S. Kannangara[4]

[1]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Homagama, Sri Lanka*
[2]*Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[3]*Centre for Water Quality and Algae Research, Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[4]*Department of Plant and Molecular Biology, Faculty of Science, University of Kelaniya, Sri Lanka*

[*]*lankaundugoda@sjp.ac.lk*

Lactobacillus species extend the shelf life of perishables by inhibiting foodborne pathogens. This study investigates the antagonistic activity of four *Lactobacillus* strains: *Lactiplantibacillus plantarum* CWJ3, *Lacticaseibacillus rhamnosus* CWKu-12, *Lacticaseibacillus paracasei* CWKu14, and *Lacticaseibacillus casei* CWM15, isolated from Sri Lankan tender coconut water, against common foodborne pathogens: *Escherichia coli*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. Each *Lactobacillus* strain was combined separately with each pathogen in a 1:1 ratio and cultured in sterile coconut water for 48 hours. During this period, pH, total soluble solids (TSS), viability, metabolites, the effect of cell-free supernatants (CFS), and aggregation properties were analyzed using standard protocols. All *Lactobacillus* strains maintained high viability (~10^6 CFU mL^{-1}), while pathogen populations declined significantly to ~10^2 CFU mL^{-1} by 48 hours. Notably, *E. coli* showed initial growth during the first 24 hours, which was subsequently suppressed and persisted for 20 days at 4 ºC. Forty-eight hours of fermentation reduced the pH (3.97±0.12 to 4.07±0.16) and TSS (2.95±0.25 to 3.30±0.50 °Brix), both remaining within acceptable limits. High-performance liquid chromatography (HPLC) confirmed lactic acid as the predominant organic acid, with *L. plantarum* CWJ3 producing the highest concentration (7.48±0.98 mg mL^{-1}). Volatile compound profiling using solid-phase microextraction and gas chromatography–mass spectrometry (SPME-GC-MS) identified key antimicrobial metabolites, primarily acetic acid and octanoic acid, followed by alcohols, aldehydes, ketones, esters, and phenolic compounds. Among the strains, *L. plantarum* CWJ3 and *L. rhamnosus* CWKu-12 produced the highest acetic acid levels (13–14% relative peak area), correlating with their greater pathogen inhibition. Their CFS effectively disrupted pathogen structure and viability. Furthermore, co-aggregation assays showed that *L. plantarum* CWJ3 and *L. rhamnosus* CWKu-12 exhibited the strongest interactions with pathogens (26–28%). Overall, the findings indicate that tested *Lactobacillus* strains are effective natural bio-preservatives, inhibiting spoilage bacteria in coconut water through organic acid production and extending its shelf life.

Keywords: *Antagonistic activity, fermented coconut water, HPLC, lactic acid bacteria, SPME-GCMS.*

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Revealed comparative advantage-based analysis of Sri Lanka's top five fruit exports with focus on COVID-19 impact

W.H. Sewwandi[1*], A.M.C.H. Attanayake[1]

[1]*Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka*

[*]*sewwand-ps20027@stu.kln.ac.lk*

Sri Lanka's fruit export sector plays a significant role in its economy as it remains a developing country. Therefore, it's necessary to assess comparative advantage, which refers to a country's ability to produce and export goods at a lower opportunity cost than its competitors, for enhancing trade performance in global markets. This study aimed to analyse the comparative advantage of Sri Lanka's top five fruit exports, including banana, mango, cashew, pineapple, and papaya, in global markets from 2004 to 2023. Additionally, to determine whether COVID-19 impact on the comparative advantage of those fruits. Sri Lanka's top five fruit exports were selected according to Sri Lanka's latest customs data, and export statistics were collected from the Food Agricultural Organization (FAO). The multiple imputation method was used to impute missing data, and a better-imputed dataset was selected based on the minimum Root Mean Squared Error (RMSE). The Revealed Comparative Advantage (RCA) index was used to assess the comparative advantage of each fruit. Since the data did not follow a normal distribution, Wilcoxon Signed-Rank test was used to determine the COVID-19 impact on comparative advantage. . According to the RCA index, papaya and pineapple have comparative advantage (average RCA>1).Other fruits have comparative disadvantage (average RCA<1). The descending order of average RCA among Sri Lanka's top five fruits was papaya (16.65), pineapple (2.88), cashew (0.77), mango (0.76), and banana (0.076). This study specifically investigated the impact of the COVID-19 pandemic on the global export market by analysing variation in RCA before and during the pandemic. According to the results (p-value< 0.05 for pineapple), COVID-19 pandemic had a significant impact on the global pineapple market. Sri Lanka holds a comparative advantage in pineapple and papaya exports, highlighting the need for evidence-based strategies and policies to enhance export performance and international competitiveness.

Keywords: *Global markets, multiple imputation, root mean squared error, trade performance, wilcoxon signed-rank test*

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Food-at-home and food-away-from-home spending in the U.S.: A macro-level econometric analysis

K.M.R.M. Navoda[1]*, J.M.M. Udugama[1], W.A.L.S. Boyagoda[2]

[1]*Wayamba University of Sri Lanka, Makandura, Sri Lanka*
[2]*University of Peradeniya, Peradeniya, Sri Lanka*

[*]*madushi.m.navoda@gmail.com*

Understanding the structural drivers of household food expenditure is essential for shaping effective nutrition and food security policy in the United States. This study aims to evaluate how institutional and economic factors influence household food-at-home and food-away-from-home spending patterns. Food-at-home refers to household spending on groceries and meals prepared at home, while food-away-from-home includes expenditures on meals consumed outside the home. The analysis focuses on four key variables: government spending on food for home use, household food production, government expenditure on institutional meals, and business-sector food provision. Using annual U.S. macroeconomic data from 1997 to 2023, as available, four econometric techniques were applied: Ordinary Least Squares, robust regression, ridge regression, and Principal Component Regression (PCR). Results show that government spending on food for home use (coefficient = 2.252, $p < 0.001$) and household food production (coefficient = 140.3, $p < 0.05$) significantly increase food-at-home spending, highlighting the role of public food programs and self-production. For food-away-from-home, government expenditure on institutional meals (coefficient = 8.938, $p < 0.01$) and business-sector food provision (coefficient = 3.168, $p < 0.001$) were statistically significant, with business-sector spending showing the strongest effect. Robust regression confirmed these results while adjusting for heteroskedasticity, yielding more precise standard errors and reinforcing confidence in the estimates. Ridge regression demonstrated coefficient stability, and PCR explained 95% of the variance in food-away-from-home and 56% in food-at-home using two components. Diagnostic plots confirmed a strong model fit with minimal outliers. Residual and Q-Q plots indicated approximate normality and homoscedasticity, Cook's distance revealed no influential points, while ridge and PCR validation plots showed stable coefficients and optimal predictive performance using minimal components. These findings reveal that institutional food investments and household production significantly shape national food consumption. This research provides robust, visual, and empirical evidence to guide system-level food and nutrition policy.

Keywords: *Household food expenditure, ordinary least squares, principal component regression, ridge regression, robust regression*

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Development and sensory evaluation of a novel hybrid processed cheese fortified with *Vigna unguiculata* (black-eyed pea)

A.P.A.E. Samaraweera[1*], M.A.L.S.S. Munasinghe[1], H.N.N. Dilrukshi[1]

[1]*Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP)60170, Sri Lanka*

**amasamaraweera99@gmail.com*

Rising environmental concerns related to animal-based food production have led to increased interest in sustainable dairy alternatives. Hybrid cheeses, a promising approach to this issue, are produced by combining plant and dairy-based components to preserve desirable sensory attributes while enhancing nutrition, cost-effectiveness, and sustainability. This study aimed to develop and evaluate a novel hybrid processed cheese fortified with *Vigna unguiculata* (black-eyed pea), an underutilized legume rich in protein, fiber, and micronutrients, focusing on its sensory appeal. Two hybrid cheese formulations were prepared by incorporating 25% (T1) and 30% (T2) black-eyed pea pulp into a semi-hard processed cheese matrix and were compared with conventional processed cheese to evaluate their sensory properties. Sensory evaluation was conducted with 30 untrained panelists using a 9-point hedonic scale for appearance, aroma, taste, texture, and overall acceptability. The collected sensory data were analysed using XLSTAT software. Just-About-Right (JAR) and Check-All-That-Apply (CATA) analyses were performed to assess sensory attributes and emotional responses. Results indicated that T2 received higher hedonic scores for texture, flavor, and overall acceptability compared to T1. JAR analysis showed that T2 closely aligned with conventional cheese in flavor (57%) and aroma (49.67%), although it was slightly weaker in color (36.67%) and texture (26.67%). CATA analysis revealed that T2 was linked to favorable attributes such as "chewy" and "uniform," together with positive emotions like "happy" and "satisfied," while T1 showed undesirable attributes and negative emotions. These findings demonstrated the feasibility of using black-eyed pea pulp, particularly at 30% incorporation, in developing a hybrid processed cheese with acceptable sensory properties. This formulation highlights the potential of legume fortification in the cheese manufacturing process and promotes sustainable agriculture through the integration of underutilized crops. Further studies on nutritional profile, physicochemical properties, and shelf-life analysis are recommended to optimize the formulation prior to commercialization.

Keywords: *Dairy, plant-based, preference, semi-hard cheese, sustainable*

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Leveraging social systems for environmental innovation: Sustainable practice adoption by agri-food SMEs in North Western Province of Sri Lanka

K.A.H. Navoda[1*], P.C. Abeysiriwardana[2], U.K. Jayasinghe-Mudalige[1], I.V. Kuruppu[1], M. Udugama[1], W.A.S. Lakmali[1], N.W.B.A.L. Udayanga[1]

[1]*Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka*
[2]*Ministry of Science and Technology, Sethsiripaya Stage 1, Battaramulla, Sri Lanka*

[*]*hashini.kodippili@gmail.com*

As a key form of environmental innovation, Environmental Management Practices (EMPs) can play an essential role in enhancing the sustainability and resilience of small and medium-sized enterprises (SMEs), particularly in the resource-based sectors, including agri-food processing in the developing world. In the light of that, this study was aimed to evaluate the impact of 'social system incentives', including: (1) Market forces; (2) Regulatory measures, and (3) Legal processes, on shaping the adoption of sustainable EMP by 50 SMEs listed under the Provincial Environmental Authority of the North-Western Province (PEA–NWP) in Sri Lanka. A semi-structured questionnaire, which covers 21 EMP items classified into Strategic, Operational and Tactical and gauged by five economic-incentive indicators [cost (COST), sales and revenue (SLR), existing government regulation (EGR), anticipated government regulation (AGR), and liability laws (LBL)], was used to collect data. Each firm was signified as a High, Moderate, or Low Adopter based on its aggregated score obtained through a Likert scale. The outcome of the analysis highlights that nearly one-third of firms in the sample had 'High' EMP implementation, with 'Operational' EMPs being the most prevalent, indicating a preference for pragmatic, short-term improvements over long-term strategic sustainability. Further analysis based on Multiple Linear Regression techniques revealed that the SLR incentive demonstrated the strongest and statistically significant positive relationship with EMP uptake ($\beta = 0.594$, $p < 0.001$), while other incentives showed a limited but evocative influence. Overall, the results emphasise the potential role of economic rewards in motivating a firm towards sustainability practices. The findings underscore the centrality of market-based motivators and suggest clear policy implications, particularly the integration of which, for example, execution of firm-friendly green-tax policies, eco-certification rewards, and preferential procurement schemes, etc., to strengthen environmental innovation, enhance production environments, and promote broader EMP adoption among SMEs.

Keywords: *Compliance behaviour, enterprise resilience, green practices, market drivers, policy instruments*

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Effects of pH and salt concentration on the textural and functional properties of mozzarella cheese

K.A.H.P. Kodikara[1*], M.A.L.S.S. Munasinghe[1], H.N.N. Dilrukshi[1]

[1]*Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila NWP, 60170, Sri Lanka.*

[*]*prabashi98kodikara@gmail.com*

Mozzarella, a stretched curd cheese made from buffalo or bovine milk, is known for its wide range of flavours, textures, along with its key functional properties. This study explores the influence of pH and salt concentration on the textural and functional properties of mozzarella cheese, which are vital for its performance. The salt concentration (2% to 10%) and pH range (5.2 to 5.4) were optimized using the Box-Behnken design of response surface methodology (RSM) with Design Expert version 13 software. Cheese samples were prepared using cow's milk and starter cultures under controlled conditions, by following thirteen different trial combinations suggested by the mentioned software. All cheese samples were analysed for heat-induced functionality (Stretchability and Meltability) and textural properties (Hardness, Cohesiveness, Gumminess, and Chewiness). Textural properties were measured by collecting separate samples from the center and the edge of each cheese. Salt concentration showed a stronger negative effect ($P < 0.05$) on meltability than pH. Stretchability of mozzarella cheese was significantly influenced by both pH and salt concentration ($P < 0.05$). The highest values for both stretchability (88.37 mm ± 0.10) and meltability (8.31 cm² ± 0.01) were observed in mozzarella cheese with 2% salt concentration and a pH of 5.2. Textural properties revealed that gumminess and cohesiveness in both the edge and center were significantly impacted by pH and salt concentration ($P < 0.05$), and a strong negative effect on cohesiveness was observed with decreasing pH. However, hardness and chewiness (both center and edge) were not significantly affected by pH or the salt concentration ($P > 0.05$). Overall, this study emphasises that both pH and salt concentration are influential factors in determining the textural and functional properties of mozzarella cheese. Understanding and optimising these parameters are essential for the dairy industry to ensure consistent product quality while improving process efficiency.

Keywords: *Acidification, brine, mozzarella cheese performance, response surface methodology*

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Evaluation of soil organic carbon content in the tank-associated adjacent environment, Mihintale, Sri Lanka

R.A.T.N. Senavirathna[1], W.D.U. Premarathna[1,2], G.A.D. Perera[3], R.R. Ratnayake[1*]

[1]*National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka*

[*]*renuka.ra@nifs.ac.lk*

The Traditional Tank Cascade Systems (TCSs) in Sri Lanka are centuries-old, nature-based solutions for water management and ecological sustainability in the dry zone. These interconnected tanks, canals, and landscapes support agriculture, regulate water flow, and conserve soil resources. Soil organic carbon (SOC) is a vital terrestrial carbon sink affecting agricultural productivity and climate regulation. This study evaluated SOC dynamics in the environment adjacent to four canal-connected tanks: *Thammennawa*, *Miriskatukeliyawa*, *Katupotha*, and *Mahakirindegama* within a well-functioning tank cascade system in Mihintale, Sri Lanka. Soil samples were collected at two depths: surface (0–15 cm) and sub-surface (15–30 cm) soil layers, and analysed for total organic carbon (TOC), bulk density using standard procedures and SOC stock was calculated. Results showed that surface soils exhibited higher SOC levels, with *Mahakirindegama* site recording the highest mean SOC (177.7 Mg C ha^{-1}), followed *Katupotha* (172.4 Mg C ha^{-1}), *Thammennawa* (133.6 Mg C ha^{-1}), and *Miris Katukeliyawa* (108.5 Mg C ha^{-1}). Subsurface SOC declined, through *Mahakirindegama* (110.4 Mg C ha^{-1}) and *Miris Katukeliyawa* (86.3 Mg C ha^{-1}) maintained relatively higher values compared to *Thammennawa* (77.64 Mg C ha^{-1}) and *Katupotha* (60.10 Mg C ha^{-1}). Higher SOC at some sites resulted from increased organic inputs and microbial activity. Paired t-test analysis revealed statistically significant SOC differences between surface and sub-surface depths in *Thammennawa* ($t = 5.03$, $p < 0.001$), *Katupotha* ($t = 4.52$, $p < 0.001$), and *Mahakirindegama* ($t = 3.02$, $p = 0.009$), indicating greater surface soil SOC retention, could be increased organic matter accumulation and enhanced microbial activity. In contrast, *Miris Katukeliyawa* showed no significant difference ($t = 1.19$, $p = 0.252$), suggesting a more uniform SOC distribution. Spatial variability in SOC content reflected the influence of hydrological connectivity, sedimentation, and land use. These results underscore the role of tank associated landscapes in enhancing soil carbon storage and emphasize the depth-dependent nature of SOC in supporting sustainable land management in traditional TCSs.

Keywords: *Carbon sequestration, organic matter accumulation, soil health, sustainable land management, tank cascade system.*

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Application of Fourier transform infrared (FTIR) spectroscopy for bond characterization and adulteration detection in coconut toddy

T.D.Y.M. Thudugala[1], B.A.T. Amalka[2]*, K.M. Binduhewa[2], T.C. Kananke[1], C.K. Dissanayake[2]

[1]*Department of Food Science and Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*
[2]*Life Sciences Division, Sri Lanka Atomic Energy Board, Orugodawatta, Wellmpitiya, Sri Lanka*

[*]*thilini.amalka@gmail.com*

Authentic coconut toddy (ACT) is a traditionally fermented beverage recognized for it's nutritional, economic, and health benefits. However, its authenticity is often compromised through adulterations with low-cost substitutes particularly artificial toddy (AT) derived from sugar-based solutions. This study aimed to identify the characteristic functional groups present in ACT and to develop a qualitative model based on Fourier Transform Infrared (FTIR) for differentiating ACT from different ATs. First, three types of AT were prepared using different fraudulent methods and all samples (including ACT) were freeze-dried to obtain solid residues. Fifteen FTIR spectra were recorded for each sample in the wavenumber range of 5500–450 cm^{-1} using FTIR coupled with Attenuated Total Reflection. Next, the characteristic functional groups were identified using previous literature. Finally, spectral data were subjected to Standard Normal Variate (SNV), Multiplicative Scatter Correction (MSC), and First Derivative transformations with the intention of pre-processing. Principal Component Analysis (PCA) and Orthogonal Partial Least Squares Discriminant Analysis (OPLS-DA) were performed to pre-processed data using SIMCA 17.0.2 software. According to the results, characteristic functional groups identified in ACT included O–H stretching (3261–2932 cm^{-1}), C=C stretching (~1632 cm^{-1}), C–C/C–O stretching (1200–800 cm^{-1}), and C=C bending (~994 cm^{-1}). PCA of SNV-pre-processed spectral data yielded the highest model performance with a higher correlation coefficient (R^2=0.99) and cross-validation (Q^2=0.99), identifying 11 principal components. In OPLS-DA, MSC-pre-processed data provided the best discrimination (R^2=0.99 and Q^2=0.92) for effective separation of ACT from three types of AT. These findings shows that FTIR spectroscopy is a cost-effective, rapid, and user-friendly analytical tool for the preliminary qualitative discrimination of ACT and AT, with potential for future quantitative model development. Moreover, the applicability of this approach can be further strengthened by incorporating toddy samples collected from different geographic regions and various harvesting seasons.

Keywords: *Artificial toddy, authentic coconut toddy, authenticity, principal component analysis, multivariate analysis*

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Formulation of chitosan-based biodegradable mulch films reinforced with eggshell powder: A sustainable alternative for soil management

R.M.C.M. Dharmasiri[1], D.T.K. Koswatta[1], W.M.W.W. Kandegama[1*]

[1]*Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka*

[*]*wishwajith@wyb.ac.lk*

The extensive application of synthetic plastic mulches in agriculture has significantly contributed to environmental pollution and public health issues by releasing micro- and nano-plastics. To address this issue, the present study focused on the formulation and characterization of chitosan-based biodegradable mulch films (BDMFs) reinforced with nano eggshell powder (ESP) as the key ingredient, aiming to introduce a biofilm as an eco-friendly and economically viable alternative for soil mulching. BDMFs were prepared via the solution casting method with different proportions of ESP. These films were subjected to a series of characterizations regarding their properties, including tensile strength (TS), elongation at break (EB), and degradation behaviour. The experiment consisted of five treatments formulated with varying concentrations of eggshell powder (ESP): 0% (control), 1%, 2%, 3%, 4%, and 5% (w/w) of chitosan. A completely randomized design (CRD) was used, and data were statistically analysed using one-way ANOVA. The mechanical strength of the films increased significantly with an increase in the concentration of ESP. TS (MPa) increases from 0.763 ± 0.568^{b} in the control (T1) to 4.642 ± 0.464^{a} in the 4% ESP film (T5). However, further increase of ESP levels led to decrease the EB (%), which indicated an increase in brittleness, where the control film showed 89.5 ± 19.5^{a} %, while the 4% ESP film showed 21.5 ± 7.0^{b} %. Although increasing ESP concentration decreased film flexibility and slowed biodegradation, it provided better mechanical integrity and environmental durability during the cropping period (30 days), mainly for crops like short-duration vegetable crops or in sustainable nursery bed management. The results indicate that chitosan-based BDMFs reinforced with ESP can easily be termed as a promising alternative to polymeric mulch films, as they prove to be an eco-friendlier option in terms of agricultural practice without losing essential functional properties during the cropping season.

Keywords: *Biodegradability, eco-friendly, environmental pollution, modern agriculture, soil mulching*

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Influence of vernalization on bolting and bulb yielding traits on cluster onion (*Allium cepa* L.) germplasm

D.R.N. Abeysinghe[1*], S.J. Arasakesary[1]

[1]*Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, Sri Lanka*

[*]*rasaraabeysinghe@gmail.com*

An experiment was conducted to find out the influence of vernalization on bolting efficiency and bulb production of different varieties of cluster onion. This experiment was carried out from February to June 2023 at the experimental area, Faculty of Agriculture, University of Jaffna, Kilinochchi. Three varieties of onion MICLO1, ARLCLO2, ANKCLO1 and an advanced breeding line TVM6 were used with vernalization at 10^0 C,13days and non-vernalization of the bulb. Treated Bulbs and untreated bulbs were sown in the field after Randomized Complete Block Design with three replications. Agronomic traits (Days to First Flower initiation, 100% Flowering Days, Flowers per umbel, Flower stalk per plant, Umbel width(cm), Seeds per umbel, Bulbs per plant, Dry bulbs weight(g). were recorded in different treatments of sampled plants. SAS program was employed for data analysis Overall, vernalization improves flowering ability, flower occurrence in umbels and umbel size, mostly vernalization controlled floral characteristics with cultivars. Cultivars differed in response to bolting and bulb yield. ARLCLO2 and MICLO1 varieties were shown bulb harvests with productions containing different bulb characteristics while TVM6 (76 Flowers/Umbel) and MICLO1 variety (54 Flowers/Umbel) were most suitable for bolting. MICLO1(4.3 Umbel Width/Plant) represents a high percentage of width of umbel under vernalize condition. MICLO1(134 Seed/Umbel) and TVM6 (125 Seed/Umbel) for true seed production.in Kilinochchi. MICLO1(6Bulbs/Plant), ARLCLO2 & ANKCLO1(5Bulbs/Plant) varieties responded to vernalization with a high number of bulbs per plant. Thus, this study clearly shows that the varieties ARLCLO2 and ANKCLO1 may be utilized for the yield of high-quality bulbs in Sri Lanka, while the advanced breeding line TVM6 and released variants and MICLO1 can be used for real seed production in Sri Lanka. According to the results of this study, the cultivars ARLCLO2 and ANKCLO1 are the best for bulb production, whereas TVM6 and MICLO1 are the best for flowering because of their maximum blooming efficiency.

Keywords: *Agronomic traits, bolting, breeding line, floral characters, true seed*

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Development and evaluation of novel plant-based nutritional formulations for spread applications

R. Andrahannadi[1], M.A. Jayasinghe[1*]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

[*]*madhura@sci.sjp.ac.lk*

With rising global health concerns, the demand for functional foods grows, yet most diets lack a balanced integration of nutrition and convenience. In response, this study develops novel plant-based nutritional formulations using mung bean sprouts (*Vigna radiata*), soybeans (*Glycine max*), and avocado (*Persea americana*), which are then adapted into affordable, ready-to-eat, nutrient-rich spreads. The objective was to formulate three targeted blends: Balanced Nutrition, High-caloric, High-protein, and assess their suitability for ready-to-eat Spread applications. Soybeans were soaked and thermally treated, and mung beans were sprouted to mitigate antinutrients and allergenic compounds. The Formulations were designed using spreadsheet-based Nutrient modelling, aligning with the Recommended Dietary Guidelines, and evaluated for chemical, physical, microbial, and cost parameters. Each formulation was transformed into a Spread, which underwent sensory evaluation for consumer acceptability. Based on results, Proximate compositions of the Formulas were varied significantly **(**$p < 0.05$**)**. High-caloric formula delivered the highest energy (288.9Kcal) and Carbohydrates (25.3%), covering 36.1% of daily energy needs per 250g, ideal for high-energy requirements. The High-protein formula showed the highest protein (19.1%) and Fat (15.8%) content, providing 35.0% of energy and an impressive 85.08% of the daily protein recommended dietary intake (RDI) per 250g – supporting high-protein dietary goals. The Balanced-Nutrient formula showed Moderate nutrient levels by contributing 27.9% of daily energy per 250g serving. Adequate antioxidant, mineral, and physicochemical profiles with four-week Microbial stability were observed. Cost per 1Kg batch was Rs. 574.00 (Balanced-nutrient), Rs.665.00 (High-caloric), and Rs.607.00 (High-protein), indicating affordability for the low-income population. The prepared spreads: Balanced-Nutrient, High-Caloric, and High-Protein showed strong overall acceptance in sensory evaluation, with no significant differences ($p > 0.05$). However, High-caloric spread was scored highly on average (8.71±0.19) for overall acceptability. In conclusion, this study developed three Multifunctional, Affordable, Nutrient-rich formulations for convenient, ready-to-eat spreads, demonstrating how science-driven food innovations bridge research and commercialization for sustainable dietary solutions.

Keywords: *Avocado, mung bean sprouts, nutrient-rich, ready-to-eat, soybeans*

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Effect of cooking in water on resistant starch contents of selected millet varieties consumed in the Jaffna region

K. Raveendiran[1*], V. Arasaratnam[1]

[1]*Department of Biochemistry, Faculty of Medicine, University of Jaffna, Sri Lanka*

[*]*ravikarthikayini@gmail.com*

Resistant starch (RS) is a type of dietary starch that escapes digestion and offers numerous health benefits. Millets, traditionally consumed in Sri Lanka, are rich in nutrients but understudied in terms of RS contents with the traditional cooking methods. This study aimed to evaluate the effect of cooking on the RS contents of five millet varieties [*Setaria italica* (foxtail millet), *Paspalum scrobiculatum* (kodo millet), *Panicum sumatrense* (little millet), *Pennisetum glaucum* (pearl millet), and *Sorghum bicolor* (sorghum)] that are commonly consumed in Jaffna region. RS contents were quantified in raw whole millet flour preparations and after cooking in well water for 15 minutes at 90°C without discarding excess water. The RS contents of the raw millet flour preparations and that of the cooked millets were estimated by AOAC 2002.02 Megazyme enzymatic method. Raw millet flour samples contained low levels of RS. Among the millets pearl millet had the highest ($1.1 \pm 0.1\%$) and the foxtail millet had lowest ($0.3 \pm 0.1\%$) RS contents ($p < 0.05$). When the foxtail millet, little millet, kodo millet, pearl millet and sorghum were cooked without excess water, the RS content was respectively increased by 5.67, 2.43, 3.88, 1.18 and 4.40 folds. Hence among the millet varieties cooking in water had increased the RS contents and among them the increase was highest in foxtail millet and least in pearl millet. The results indicated that cooking in water can significantly enhance RS levels in millets ($p < 0.05$), although the change varied based on the type of the millet. These findings highlighted that the cooking of millets improved the RS levels, further studies have to be carried to compare the effects of different types of traditional cooking methods on the changes in RS.

Keywords: *Cereals, cooking, nutritional composition, traditional food*

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Application of silica to increase solubility of apatite: A preliminary study

P.L.G.S. Nisansala[1], M.N.M. Farhath[1*], T.B.N.S. Madugalla[2], M.S. Kandanapitiye[3]

[1]*Department of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sri Lanka*
[2]*Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sri Lanka*
[3]*Department of Nano Science Technology, Wayamba University of Sri Lanka, Sri Lanka*

**mmohamed@seu.ac.lk*

Phosphorus is an essential macronutrient for plant growth, predominantly supplied through fertilizers derived from apatite. However, the limited water solubility of apatite, particularly Sri Lankan *Eppawala* rock phosphate, restricts its direct application in agriculture. This study investigated the application of silica as a solubility-enhancing agent to improve apatite dissolution under reduced sulphuric acid conditions. Initially, the particle size of apatite powders was optimized and identified the 125 µm - 250 µm size range as yielding the highest solubility. Using this size fraction, apatite-to-silica mass ratios from 1:1 to 1:10 were tested and the 1:5 ratio was identified as optimal. Subsequently, the optimized parameters (125 µm - 250 µm particle size and 1:5 ratio) were further evaluated under varying sulphuric acid concentrations (10–70%) using a factorial design with triplicates. Control experiments without silica were included for baseline comparison. Phosphate release was quantified using UV-visible spectroscopy, while structural analyses were conducted using Fourier Transform Infrared Spectroscopy (FTIR) and Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Furthermore, silica was synthesized from rice husks through an eco-friendly sol-gel method, offering a low-cost, sustainable alternative to commercial silica, with potential economic viability for large-scale production. Results showed that the 1:5 apatite-to-silica ratio without acid yielded 16-17 mg l^{-1} phosphate. Critically, the same ratio combined with 50% sulphuric acid achieved 390 mg l^{-1} phosphate, comparable to the solubility obtained with 70% acid treatment alone, indicating a 20% reduction in acid requirement. At 70% acid, silica addition further enhanced apatite solubility from 395.66 mg l^{-1} to 608.33 mg l^{-1}. This study presents silica-assisted apatite dissolution as a commercially viable approach for phosphate fertilizer production, reducing sulphuric acid consumption while maintaining high solubility and promoting agricultural waste valorization.

Keywords: *Apatite dissolution, phosphate fertilizer, rice husk valorization, silica enhancement, sustainable agriculture*

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In-vitro bioassay of neem (*Azadirachta indica)* oil-functionalized nano-silica as an antifungal agent against *Rhizoctonia solani*

D.T.K. Koswatta[1], R.M.C.M. Dharmasiri[1], W.M.W.W. Kandegama[1*]

[1]*Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Sri Lanka*

[*]*wishwajith@wyb.ac.lk email*

Advancing environmentally friendly and novel approaches to plant disease control is essential to minimize dependency on harmful chemical pesticides in modern agriculture, which contribute to soil degradation, environmental pollution, water contamination, and cause harm to non-target organisms and pesticide resistance. This study aimed to formulate and evaluate a commercially available neem oil *(Azadirachta indica)* functionalized nano silica emulsion as a novel bio pesticide against *Rhizoctonia solani*, a destructive soil-borne fungal pathogen responsible for numerous agricultural crop diseases, including damping off, root rot, and foliar blights in crops like rice, soy bean, potato, and tomato. Emulsions were produced using nano silica at concentrations of 200 ppm, 300 ppm, and 400 ppm, with a fixed neem oil content of 3% and an optimized oil-to-surfactant (Tween 20) ratio of 1:3 to attain a stable emulsion. Seven treatments were done to analyse antifungal efficacy. Three treatments obtained 5 mL of the different nano-emulsions with potato dextrose agar (PDA), and the antifungal efficacy of neem extract alone, without neem extract or nano silica (Control), two synthetic fungicides (Captan, Carbendazim) were analysed. Commercial synthetic fungicides Captan (50% WP) and Carbendazim (50% WP) were utilized as conventional fungicides for efficacy comparison. A completely randomized design (CRD) was employed for experimentation, and data were statistically analysed using one-way ANOVA. Results demonstrated fungal growth inhibition rates of Captan and Carbendazim achieved 100% and 92% respectively. In particular, the 400 ppm neem oil-coated nano silica emulsion exhibited the most effective antifungal activity (94.44%) compared to other nano-emulsion concentrations (85.92% at 300 ppm and 76.84% at 200 ppm) and the 3% neem oil control (65.73%). These results demonstrated that neem oil nanoemulsions synergize the antifungal properties of plant extracts with the advantages of nano technology and these findings highlight the potential of neem oil-functionalized nano silica emulsions as effective and eco-friendly alternatives for managing fungal diseases in crop production. Further research should validate these findings in field trials.

Keywords: *Antifungal activity, emulsion stability, oil in water emulsion, pesticide synergistic effect*

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Enhancing climate resilience in food supply chains: the impact of traceability and bottleneck analysis on small and medium-sized enterprises sustainability

V.S. Danthanarayana[1*], R.N. Weerasinghe[1], J.W.A.U. Yasas[2]

[1]*University of Sri Jayewardenepura, Nugegoda, Sri Lanka,*
[2]*Cardiff Metropolitan University, Wales, United Kingdom*

**vishwasan1996@gmail.com*

This study examines how integrating traceability systems with bottleneck analysis can strengthen climate resilience and sustainability in Small and Medium-sized Enterprises (SMEs) within food supply chains. This topic is increasingly critical yet under-researched, marking an early effort to link supply chain resilience, sustainability, and technological adoption in SMEs. The research investigates the synergistic impact of combining digital traceability tools with bottleneck analysis on SME sustainability and adaptive capacity. A mixed-methods approach was used, integrating a systematic literature review with empirical case studies from diverse agri-food sectors to bridge theoretical foundations and practical applications. The review synthesized existing knowledge on digital traceability systems powered by Blockchain, the Internet of Things (IoT), and Artificial Intelligence (AI) in enhancing visibility and sustainability within food supply chains. Empirical case studies provided real-world insights into implementation challenges and successes, while a questionnaire captured SME practices, challenges, and perceptions of these technologies. Findings show that digital traceability significantly enhances visibility, enabling SMEs to anticipate and respond to climate-induced disruptions, thus improving resilience. When combined with bottleneck analysis, these tools help identify operational vulnerabilities and optimize resource allocation under uncertainty. The joint implementation improves adaptive capacity, operational efficiency, and resource optimization while supporting circular economy principles such as waste reduction, by-product valorization, and regenerative practices contributing directly to the Sustainable Development Goals. However, barriers remain, including financial constraints, technical expertise gaps, and limited institutional support. The study's originality lies in its integrated focus on traceability and bottleneck analysis for SME resilience and sustainability. This study proposes a conceptual framework for integrating these strategies effectively. The research highlights that embedding these strategies offers a practical pathway to building climate-resilient, sustainable food supply chains and calls for policy interventions, capacity-building, and collaborative networks to support digital transformation across the sector. As the conclusion underscores a critical need for integrated strategies to bolster SME resilience against increasing climate variability and market complexities.

Keywords: *Blockchain, digitalization, risk management, adaptive capacity*

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Effects of storage duration and cultivated season on cooking characteristics of selected improved and traditional rice varieties in Sri Lanka

H.M.N.S. Bandara[1], B.M.K. Senarathna[2], B.D.R. Prasantha[1*]

[1]*Department of Food Science and Technology, University of Peradeniya, Peradeniya*
[2]*Rice Research and Development Institute, Bathalagoda, Ibbagamuwa*

**bdrp@pdn.ac.lk*

Rice grain quality is a combination of physical and physicochemical parameters. Most crucial aspects are cooking and eating qualities since they satisfy consumers and regulate market prices. Fluctuations in environmental conditions (in *Yala* and *Maha* seasons) during growth and development of rice grains, together with variation in post-harvest storage duration, may result in significant changes in rice grain quality. This study evaluates the variation of amylose content, gel consistency, grain elongation, and gelatinization temperature of 12 improved and traditional rice (*Oryza sativa L.*) varieties (*Bg450, Bg352, Bg360, Bg366, Bg374, At311, At362, Ld253, Pachchaperumal, Madathawalu, Herathbanda, and Suduheenati*). They were grown experimentally across three seasons: 2023 *Yala*, 2023/24 *Maha*, and 2024 *Yala*. Samples were stored for 3, 10, and 15 months, respectively under ambient conditions (25 ^{o}C and 65% RH) until the study. Significant differences ($p<0.05$) were observed in amylose content, gel consistency, and grain elongation due to the interaction between variety and cultivation season. Gelatinization temperature (GT) remained statistically unchanged ($p>0.05$) among the seasons with most varieties exhibiting intermediate (68.94 ^{o}C), high intermediate (70.34 ^{o}C), or high (71.74 ^{o}C) GT. Only *at 311* showed a low GT of 64.74 ^{o}C. Amylose content and grain elongation significantly varied in 2023 *Yala* from the other two seasons, with no significant differences ($p>0.05$) between 2023/24 *Maha* and 2024 *Yala* seasons. The highest amylose content (31.97 ± 0.72%) was recorded for *Madathawalu* in 2024 *Yala*, whereas *Bg366* showed the highest grain elongation ratio (1.59 ± 0.04) in the same season. Gel consistency differed significantly ($p<0.05$) between 2023/24 *Maha* and 2024 *Yala* seasons, while the 2023 *Yala* season did not significantly differ ($p>0.05$). Findings showed that some cooking quality characteristics of rice vary based on their cultivation season and storage durations, providing insights for commercial cultivation and optimizing postharvest storage of rice in Sri Lanka.

Keywords: *Amylose content, gelatinization temperature, gel consistency, grain elongation, seasonal variation*

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Effect of habitual mastication behaviour on glycaemic response to structurally distinct white finger millet and multigrain breads in healthy adults

T.M.P.M. Tennakoon[1], G.M. Somaratne[1]*, B.D.R. Prasantha[1]

[1]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka*

**gsomaratne@agri.pdn.ac.lk*

The relationship between mastication parameters and postprandial blood glucose level is underexplored in research contexts. The aim of this study was to investigate the relationship between habitual mastication behaviour and glycaemic response in non-diabetic healthy individuals by testing three commercially available breads: white, finger millet, and multigrain, during *in vivo* glycaemic index (GI) and mastication studies. Twenty-two non-diabetic healthy volunteers (BMI: 21.3±1.5 kg/m ²; age: 23–28 years) participated in both GI and mastication studies. The glycaemic response trials were conducted following the standard FAO/WHO protocol, measuring blood glucose responses over a two-hour period post-consumption. Mean oral bolus particle size, extent of oral starch hydrolysis, number of mastication cycles, mastication duration and mastication frequency were evaluated via the mastication studies. Certain mastication parameters such as mastication duration, number of mastication cycles and mastication frequency for a standard portion size, varied significantly ($P < 0.05$) among individuals. Though the mean oral bolus particle size at the point of swallowing did not differ significantly ($P > 0.05$) within a specific bread type, supporting the concept of the critical particle size threshold theory. On the basis of correlation analysis, except for a significant correlation ($P < 0.05$) between the degree of starch hydrolysis in the oral cavity and GI values in multigrain bread, no significant correlations ($P > 0.05$) between individual GI values and parameters of mastication were observed. Even though there were no direct correlations, Principal Component Analysis (PCA) identified a moderate positive relationship between starch hydrolysis extent (0.65) and GI (0.53) and a moderate negative relationship between mean oral bolus particle size (-0.54) and GI (0.53), with a focus on oral processing impact on glycaemic response. Thus, these findings suggest that mastication influences glycaemic response, particularly for multigrain bread, and support further research using advanced biomechanical and imaging tools to refine dietary recommendations for blood glucose management.

Keywords: *Glycaemic index, mastication cycles, mastication duration, oral bolus, oral processing, starch hydrolysis*

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Impact of ripening on glycaemic index, chemical composition, and antioxidant properties in "*Embul*" and "*Kolikuttu*" banana varieties in Sri Lanka

L.U. Athukorala[1], B.D.R. Prasantha[1*], G.M. Somaratne[1], K.D.T. Hettige[2]

[1]*Department of Food Science and Technology, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*National Institute of Postharvest Management, Anuradhapura, Sri Lanka*

[*]*bdrp@pdn.ac.lk*

'*Embul*' and '*Kolikuttu*' banana varieties are two most consumed banana varieties in Sri Lanka. This study investigated the influence of ripening stages on glycaemic index (GI), resistant starch (RS) and digestible starch (DS), and starch-sugar transformations in '*Embul*' (AAB) and '*Kolikuttu*' (AAB) banana varieties. Fruits were analyzed at three ripening stages; green-yellow (unripe), yellow with green tips (partially ripe), and fully yellow (fully ripe), in relation to natural banana ripening. Banana samples were obtained from a local supplier at fully green stage. Glycaemic index (GI) was determined *in-vivo* using ten healthy volunteers following FAO/WHO (1998) protocols, measuring blood glucose over 2 hours post-consumption. Analysis of starch fractions was carried out using Megazyme® Assay Kit (AOAC Method 2002.02). Methanol extracts were analyzed for total phenolics (Folin-Ciocalteu), total flavonoids (Aluminum chloride colorimetric assay), and DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical scavenging activity. With natural ripening, RS content varied from 12.46±1.02 to 4.54±1.14 g/100 g ('*Embul*') and from 12.15±0.54 to 3.06±0.60 g/100 g ('*Kolikuttu*'). '*Embul*' and '*Kolikuttu*' varieties had low GI at the yellow with green tips stage (41.08±4.04 and 37.86±2.51, respectively), and maintained low GI status even when fully ripened (52.26±4.76 and 52.17±4.33, respectively). '*Kolikuttu*' variety exhibited higher phenolic (389.60±15.30 mg Gallic Acid Equivalents/100 g) and flavonoid (208.75±46.61 mg Rutin Equivalents/100 g) content than '*Embul*' banana at the fully yellow stage, with higher antioxidant activity (88.36±0.18%). Both banana varieties had shown low GI even at fully yellow ripening stage. Antioxidant properties had increased during ripening and the highest contents had observed at fully yellow stage.

Keywords: *Antioxidant activity, banana, natural ripening, resistant starch*

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Ultrasound-assisted extraction of dietary fibre from *Citrus aurantifolia* peel and evaluation of its physiochemical properties and gastro-intestinal behaviour

J.C. Hewawitharana[1]*, K.D.P.P. Gunathilake[1]

[1]*Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila*

[*]*jeewanichathumi@gmail.com*

Citrus peels, often discarded as waste, hold immense potential as a sustainable source of dietary fibre with functional food applications. Dietary fibre is an important component of a healthy diet, as it can lower the risk of chronic diseases such as diabetes, cardiovascular disease, and obesity. This study focused on the extraction and characterization of fiber extracted from *Citrus aurantifolia* peel (Key Lime) to assess its physicochemical properties and gastrointestinal behaviour. First, Dietary fiber was extracted using three different methods including acidic extraction with heating (1% citric acid, 90 °C,60 min) – assisted ultrasonication, acidic (1% citric acid) and alkaline (1% NaOH) extractions with ultrasonication alone. Ultrasonication parameters were precisely controlled at a frequency of 40 kHz, 100W and varying durations (20, 30 and 60min) with a controlled temperature of 40 °C. As of physicochemical characterization, water-holding capacity (WHC), oil-holding capacity (OHC) and water-swelling capacity (WSC) were evaluated. In addition, Cholesterol absorption capacity (CAC) and bile salt absorption capacity (BAC) were assessed in simulated gastrointestinal conditions using the Wang's method. According to the results, heating-assisted ultrasonication (60 min) with 1% citric acid exhibited the highest total dietary fibre (TDF) yield with significant variations across peel fractions. (Albedo: 66.11 ± 4.49%, Flavedo: 64.98 ± 7.82%, Pomace: 75.96 ± 14.75%). Insoluble dietary fiber (WHC: 6.45 ± 2.64 and OHC: 4.85 ± 0.25) and TDF (WHC: 6.91 ± 0.06, OHC: 5.04 ± 0.44) exhibited superior values whereas soluble dietary fiber (SDF) resulted the highest WSC (15.85 ± 0.40 g/g). Differences were statistically confirmed using ANOVA ($p<0.05$). Extracted fiber demonstrated promising results in CAC: (1.45 ± 0.07 mg/g at pH 7) and BAC: (0.05 ± 0.003 mg/g) suggesting these mechanisms may reduce cholesterol absorption in the gut, enhancing bile acid sequestration and lower LDL levels, highlighting its potential of managing hypercholesteromia. Thus, these findings revealed the potential of *Citrus aurantifolia* peel fibre as a functional food ingredient while contributing towards sustainable waste management.

Keywords: *Citrus aurantifolia peel, cholesterol binding, dietary fiber, ultrasonication, water-holding capacity*

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A data-driven carbon footprint assessment of intensive dairy farming in upcountry Sri Lanka

R.D.D.R.C. Jayarathna[1], J.K. Vidanarachchi[1], G.L.L.P. Silva[1], S.P. Nissanka[2], S.P. Kodithuwakku[1*]

[1]*Department of Animal Science, University of Peradeniya, Sri Lanka*
[2]*Department of Crop Science, University of Peradeniya, Sri Lanka*

[*]*surangap@agri.pdn.ac.lk*

The global carbon footprint of the dairy sector has become a focus of discussion in the context of climate change, due to its contribution to greenhouse gas (GHG) emissions. Since, country-specific carbon footprint (CF) assessments are scarce, Sri Lanka has to rely on default estimates. This pilot study aims to fill this gap by estimating the emission factors of large-scale intensive dairy farming in the upcountry of Sri Lanka through a data-driven approach, providing a foundation for developing sustainable, evidence-based mitigation practices in the future. The study adopts the IPCC Tier-2 methodology to estimate emission factors, with fat and protein corrected milk (FPCM) as the functional unit. Data were collected from Lonach Dairy Farm in Watawala, an intensive large-scale dairy farm in upcountry Sri Lanka. The sample included 20 Friesian cows, five from each category: heifers, early lactating, peak lactating, and dry cows. Manure, milk, and feed samples from each cow, along with farm-based data on energy use and production, were collected. A newly developed, user-friendly Excel tool based on IPCC guidelines was used to facilitate emission calculations. Simultaneously, enteric methane emissions were quantified across selected cow categories and manure pits using a custom-built, Arduino-based low-cost methane sensor. Real-time measurements were compared against IPCC Tier-2 calculations. The study reveals that the overall CF was 3.36 kg CO_2e per kg FPCM per year in the farm. This value is notably lower than the FAO's default estimate of 4.80 kg CO_2e for similar dairy systems. The findings of this pilot study highlight a clear disparity between quantified data and default values, emphasizing the importance of developing accurate, locally derived emission factors. This research contributes to developing robust emission benchmarks essential for effective mitigation strategies and sustainable dairy farming management by integrating real-time, industry-specific data and user-friendly tools like the Excel model.

Keywords: *Arduino-based sensors, enteric methane, emission factors, greenhouse gases, global warming.*

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Development and quality evaluation of functional bread fortified with dietary fiber extracted from coconut kernel

S.A.S.K. Samarathunga[1], B.G.R.R. Bandara[1*], L.L.W.C Yalegama[1], K.M. Somawathie[2]

[1]*Coconut Research Institute, Lunuwila, Sri Lanka*
[2]*Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*

**ranahansibandara@gmail.com*

Bread is a globally consumed staple and offers a promising base for the incorporation of functional ingredients to enhance nutritional and health benefits. This study focused on the development of bread fortified with dietary fibre extracted from Defatted Desiccated Coconut Residue (DDCR), a by-product of virgin coconut oil production. Three bread formulations were developed: 0% (control), 5%, and 7.5% (w/w) DDCR fibre. Proximate analysis, color and texture, total phenolic content, digestible starch content, glycemic index by invitro digestion method and fourier transform infrared spectrum (FTIR) of bread samples were analysed using standard methods. The 7.5% (w/w) DDCR bread showed a significantly higher crude fibre content (1.98 ± 0.46 g/100 g, dry weight basis) compared to the control (0.74 ± 0.33 g/100 g, dry weight basis) ($p < 0.05$. Digestible starch content was significantly reduced in the 7.5% DDCR bread (0.22 ± 0.01 g), compared to 5% DDCR bread (0.24 ± 0.01 g) and control (0.32 ± 0.02 g) ($p < 0.05$). The glycaemic index was significantly lowered from 80.48 ± 2.15 in the control to 60.93 ± 1.92 in the 5% formulation and 58.15 ± 1.30 in the 7.5% formulation ($p < 0.05$). Texture profile analysis showed significantly increased firmness with fibre addition, with the 7.5% DDCR bread reaching 921 ± 43.7 g compared to 95.1±20.9 g in the control ($p < 0.05$). Total phenolic content decreased significantly, from 16.21±0.010 mg GAE/g in the control to 11.11±0.01 mg GAE/g in 7.5% DDCR bread ($p < 0.05$) which was associated with a reduction in antioxidant capacity. FTIR analysis revealed structural modifications in O-H (3277.24–3280.19 cm^{-1}), C=O (1742.46 cm^{-1}), and C-O (570.69 cm^{-1}) regions, indicating molecular interactions between DDCR fibre and the bread matrix. These findings demonstrate that DDCR fibre significantly improves bread's nutritional quality, and structural properties while reducing starch digestibility and glycaemic impact.

***Keywords**: Bread firmness, digestible starch, glycaemic index, molecular interactions, phenolic content*

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Agronomic biofortification of microgreens with Zn and Fe micronutrients via nutri-priming and fertigation

K.G.S.D. Nawarathne[1*], L.M. Rankoth[1], K.M.S. Wimalasiri[1], L.D.B. Suriyagoda[1], R. Chandrajith[2], N.R.N. Silva[3], D.M.D.P. Mapagedara[3], S. Samitha[1]

[1]*Faculty of Agriculture, University of Peradeniya, Sri Lanka*
[2]*Faculty of Science, University of Peradeniya, Sri Lanka*
[3]*Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka*

**sachininawarathne2@gmail.com*

Inadequate dietary micronutrient intake adversely affects human health and development, leading to malnutrition. Agronomic biofortification has emerged as a winning tactic to enhance the nutritional value of crops by elevating the levels of vital micronutrients in the edible part of plants. Microgreens are nutrient-dense young plants that can be eaten and confer immense health benefits. They are rich in antioxidants that support the health defences of cells, while their rapid growth and biofortification qualities offer a green solution to the problem of micronutrient deficiency. Therefore, the present study evaluated the agronomic biofortification potential of Zn and Fe for selected microgreen species to develop a nutrient-dense, plant-based food that can be grown in a small container within two weeks. The selected microgreen species were Cabbage (*Brassica oleracea* var. *capitata*), Beet (*Beta vulgaris*), Mustard (*Brassica juncea* L.), and Finger millet (*Eleusine coracana*). The experiment was conducted at the Department of Crop Science, Faculty of Agriculture, University of Peradeniya, following a Completely Randomised Design (CRD) with four treatments and four replicates. The treatments included a control (without minerals), 10 ppm ZnSO4 solution, 10 ppm FeSO4 solution, and ZnSO4 and FeSO4 combination, 5 ppm each. The 10 ppm concentration was selected based on prior research findings, which indicated this level to be effective in promoting seedling growth. The respective treatment combinations were used for nutri-priming and fertigation. Results indicated no significant differences ($p>0.05$) in seedlings' fresh weight, dry weight, pigment and antioxidant accumulation. Zn and/or Fe accumulation in all four crops also showed no significant difference ($p>0.05$) between treatments. In conclusion, Future studies should explore a dilution series with higher and varied concentrations, along with different treatment methods such as foliar application and combined nutrient priming, to identify optimal conditions for effective biofortification and improve nutrient quality.

Keywords: *Edible seedlings, food sustainability, hidden hunger, mineral supplementation, nutritional security*

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Development of a probiotic low fat dairy drink

D.M.N.S. Dissanayake[1], N.S. Weerakkody[1*]

[1]*The Open University of Sri Lanka, Nawala, Sri Lanka*

[*]*nweer@ou.ac.lk*

The rising demand for functional foods has encouraged the development of probiotic-enriched dairy products with improved health benefits. This study aimed to formulate a low-fat (0.1% milk fat by separating the fat) dairy drink enriched with a newly isolated strain of *Lacticaseibacillus rhamnosus* in both encapsulated and non-encapsulated forms. Sodium alginate was used for encapsulation, and four treatments were prepared: T1 (non-encapsulated), T2 (encapsulated), T3 (combination of encapsulated and non-encapsulated), and T4 (control). Sensory, physicochemical, and microbial properties were evaluated during refrigerated storage (4 °C) for seven days. T3 showed the significantly highest ($p<0.05$) sensory scores for the taste and overall acceptability after 1st and 7th day of storage. In addition, T3 showed significantly low ($p<0.05$) pH (5.33± 0.01) on the 7th day compared to the initial day, after 24 hours and the 3rd day of storage. There was no significant difference ($p>0.05$) in acidity (0.55± 0.03) in T3 and T4 on the 7th day of storage, indicating that encapsulated bacteria did not affect excessive acid development. The viable probiotic count of T3 (9.44 ± 0.02 $\log_{10}$ CFU/ml) had nearly 9 $\log_{10}$ CFU/ml, which contributes to the standard probiotic count of a probiotic drink. The combination of encapsulated and free *L. rhamnosus* new strain successfully produced a stable, acceptable, and microbiologically viable low-fat probiotic dairy drink with a shelf life of about six days. Further research needed to focus on optimizing encapsulation, evaluating consumer acceptability on larger scale and clinical validation to evaluate health benefits.

Keywords: *Bacteria encapsulation, dairy products, Lacticaseibacillus rhamnosus, sensory characteristics*

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Determination of the antibacterial effect of the aqueous extract of *Pterocarpus marsupium* latex

M.L.M. Wickramasinghe[1*], G.P. Arulpragasam[1], D.N.A.W. Samarakoon[1]

[1]*KIU University, Battaramulla, Colombo, Sri Lanka*

[*]*b6b6831@kiu.ac.lk*

Pterocarpus marsupium (Sinhala name: Gammalu) is a large deciduous tree which is recognized as an invaluable source of different natural compounds for the production of the traditional and allopathic medications for a range of diseases and the creation of industrial products. This species exhibits a wide range of pharmacological properties, including antidiabetic, antimicrobial, anti-triglyceridemic, cardiotonic, anti-cataract, and hepatoprotective effects. This study determined the antibacterial activity of the aqueous extract of the latex of the above plant against *Staphylococcus aureus* (ATCC 25923), *Bacillus cereus* (ATCC 14579), *Enterococcus faecalis* (ATCC 29212), *Klebsiella pneumoniae* (ATCC 700603) and *Escherichia coli* (ATCC 25922). Antibacterial activity was determined by the well diffusion method showed zone of inhibition (ZOI) after 48 hours of incubation, ranging from 2.56 – 1.11 mm, observed only for the gram-positive bacterial strains listed above. The well diffusion assay was triplicated and the mean ZOI was calculated. The crude extract of the water-soluble fraction of the latex showed a ZOI of 2.56 ±0.06 mm against *Bacillus cereus,* which was higher than the ZOI produced by the control drug 'Vancomycin' (1.90±0.18 mm). The average ZOI against *Enterococcus faecalis* and *Staphylococcus aureus* was 1.73 ±0.04 mm and 1.86 ±0.06 mm respectively. Further tests were performed to evaluate the minimum inhibitory concentration (MIC) using broth dilution method and the aqueous extract exhibited a notable activity by inhibiting *Bacillus cereus* at 0.001 g/ml, *Enterococcus faecalis* at 0.025 g/ml and *Staphylococcus aureus* at 0.0125 g/ml. A visible inhibition was not observed against gram-negative bacterial strains with the aqueous extract of the plant latex. In conclusion, the aqueous extract of *P. marsupium* had a notable antibacterial effect against all the tested gram-positive bacterial strains including *Staphylococcus aureus, Bacillus cereus* and *Enterococcus faecalis*. Further studies should be conducted to evaluate the antimicrobial effects of the ethanolic extract of *P. marsupium* latex against additional bacterial species.

Keywords: *Pterocarpus marsupium, broth dilution method, minimum inhibitory concentration (MIC), well diffusion method, zone of inhibition (ZOI).*

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Evaluating the acute phytotoxicity of *Osbeckia octandra* aqueous extract using *Lactuca sativa* bioassay: A toxicity study on *Lactuca sativa*

H.D.T. Madhuranga [1,2], K.D.M. Manthila[1*], R.M.T.S. Rathnayaka[1], M.R.K. Farween[1], D.N.A.W. Samarakoon[1], N.D.K. Ranadeeva[1], A.R. Jayamaha[2], A.S. Hapuarachchi[2]

[1]*Department of Biomedical Science, Faculty of Health Science, KIU, Sri Lanka*
[2] *Research and Innovation Division, KIU, Sri Lanka.*

**manthilamashi@gmail.com*

Osbeckia octandra (*Heen Bovitiya*) belongs to the family Melastomataceae and is utilized in various Ayurvedic preparations to treat diseases such as diabetes mellitus, ascites, hepatitis, jaundice, and hemorrhoids in Sri Lanka. Even though the medical properties of *O. octandra* have been extensively studied, the toxicity of the aqueous leaf extract remained unknown. This study aims to evaluate the acute phytotoxicity of *O. octandra* aqueous plant extract using the *Lactuca sativa* acute toxicity assay. After the authentication of plant materials, an Aqueous extract of *O. octandra* was prepared from the aerial parts (leaves) via maceration, and two-fold dilutions ranging from 0.5 to 1000 mg/mL were prepared. 25 *L. sativa* seeds were sown on filter paper in sterilized Petri dishes and moistened with prepared plant extract concentrations, along with positive control (copper sulfate) and negative control (dechlorinated water), and incubated at 22 ± 2 °C for 7 days, after which germination count, root length, and hypocotyl length were measured. Data from triplicate assays were analysed using one-way ANOVA in GraphPad Prism 10. The aqueous extract of *O. octandra* significantly inhibited *L. sativa* root growth in a dose-dependent manner when compared with the negative control ($EC_{50} = 137.82$ mg mL^{-1}, $r = 0.79$, $p < 0.0001$). Root length markedly reduced at 250 mg mL^{-1} (0.2 ± 0.07 cm). A statistically significant inhibition of seed germination was also observed ($EC_{50} = 58.12$ mg mL^{-1}, $r = 0.96$, $p < 0.0001$), where germination percentage declined progressively with increasing concentrations, exceeding 50% at ≤31 mg mL^{-1}. Hypocotyl length varied significantly across treatments ($EC_{50} = 57.82$ mg mL^{-1}, $r = 0.96$, $p < 0.0001$), with the control showing the greatest length (4.6 ± 0.92 cm) and the highest among treated groups at 4 mg mL^{-1} (4.5 ± 1.23 cm). The aqueous extract of *O. octandra* showed clear, dose-dependent inhibition of *L. sativa* seed germination, root, and hypocotyl growth. The root EC_{50} values of 137.82 mg mL^{-1} indicate moderate phytotoxicity based on established thresholds. While traditionally used in Ayurvedic medicine, the observed phytotoxic effects at higher concentrations highlight the importance of further toxicological evaluation. To support its safe use, activity-guided fractionation is recommended to isolate and identify bioactive compounds with lower toxicity.

Keywords: *Acute toxicity, lettuce bioassay, phytotoxicity, root elongation, seed germination*

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Anti-inflammatory activity of organic solvent fractions from *Ulva* sp. in LPS-stimulated RAW264.7 cells: A year-round comparison

N.J. Senevirathna[1,2*], S-Y. Heo[1,2], E-A. Kim[1], N. Kang[1], J-H. Heo[1], S-J. Heo[1,2]

[1]*Jeju Bio Research Centre, Korea Institute of Ocean Science & Technology (KIOST), Jeju 63349, Republic of Korea*
[2]*Department of Marine Technology Convergence Engineering (Marine Biotechnology), Korea National University of Science & Technology (UST), Daejeon 34113, Republic of Korea*

[*]*navodasenevirathna.948@gmail.com*

Ulva sp., is a green seaweed rich in bioactive metabolites, and a potential candidate for pharmaceutical and biomedical applications. Despite its recognized potential for utilization, it still remains underexplored, emphasizing continued research. Moreover, the excessive growth of *Ulva* has negatively impacted in the degradation of marine biodiversity. These aspects further draw attention to future research to both harness its bioactive potential and address sustainable marine ecosystem management. This study evaluated the anti-inflammatory activity of organic solvent fractions derived from *Ulva* sp. in lipopolysaccharide (LPS)-stimulated RAW264.7 cells. Among the tested fractions, hexane and chloroform (UCHL) fractions significantly reduced nitric oxide (NO) production without cell cytotoxicity ($p<0.01$). Notably, the chloroform (UCHL) fractions collected in March (UCHL3) and May (UCHL5) exhibited the lowest IC_{50} values and were selected for further analysis of pro-inflammatory cytokines production and relative mRNA expression. Both UCHL3 and UCHL5 markedly suppressed the production of pro-inflammatory cytokines, including tumor necrosis factor-α (TNF-α) and interleukin-6 (IL-6), and downregulated the mRNA expression of inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2). Among the two, UCHL3 exhibited stronger inhibitory effects on both cytokine production and mRNA expression levels. These findings highlight the seasonal variability in the anti-inflammatory activity of *Ulva* sp. chloroform fraction and reveal the potential of the UCHL3 fraction as a candidate for a pharmaceutical and nutraceutical agent.

Keywords: *Bioactive metabolites, cytokine suppression, gene expression regulation, nitric oxide inhibition, seasonal variation*

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Novel genetic circuit for the identification and bioremediation of toluene, benzene, and nitric oxide air pollutants

W.D.K. Wijesinghe[1], H.M.L. Herath[1], D.R. Gimhani[1], M.A.M.A. Shahan[1], S.V.S.M.P. Sooriyapperuma[1], J.M.D.N. Abesekara[1*]

[1]*Department of Biotechnology, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka.*

[*]*thehara210@gmail.com*

The World Health Organization (WHO) has listed NOx and Volatile Organic Compounds (VOCs), mainly Toluene and Benzene as significant primary air pollutants. These pollutants contribute to the formation of secondary pollutants such as ground level-ozone and fine particulate matter which are adversely impacting the ecosystem. The present study aimed to introduce an effectively simulated, novel genetic circuit capable of detecting and simultaneously bioremediating Benzene, Toluene, and Nitric Oxide (NO). The well-designed gene circuit integrates biosensing modules that enable real-time monitoring of pollutant levels, thereby facilitating targeted and responsive bioremediation interventions. The use of AutoDock Vina along with PyRx software led to the revelation of the Nitric Oxide binding affinity at -3.2 kcal/mol with the H-NOx receptor in *Shewanella woodyi*. One-way ANOVA followed by TukeyHSD analysis showed that the TodS receptor displayed significantly greater affinity toward Toluene and Benzene ($p<0.05$) than other receptors with binding energies of -6.5 kcal/mol and -5.6 kcal/mol. These interactions suggest that TodS from *Pseudomonas putida* DOT-T1E plays a key role in pollutant bioremediation. The signalling pathway was designed based on the logical gate framework by using CellDesigner software. When exposure to a ligand that binds to a specific receptor triggers an almost immediate response from the circuit in about 0.6 seconds, through the emission of blue fluorescence. At the same time, it will produce degradation enzymes. This bioengineered system achieved complete bioremediation of the target compounds within 35 seconds, showing a potential strategy for managing air quality. The effectiveness and efficiency of this circuit were evaluated using steady-state analysis, metabolic control analysis, and Lyapunov exponent analysis in Copasi software simulations and further experimental validation is necessary to establish its feasibility for environmental and biosensing applications.

Keywords: *Bio-computing, copasi, logic gate, tods/todt system, ligands*

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Colonization with selected extended spectrum beta lactamase producing enterobacterales in pregnant women in Eastern Sri Lanka

F.S.S. Mafras[1,2*], V.R. Francis[3], H.S.W.S. Kudagammana[1], R. Dissanayake[1], V. Liyanapathirana[1]

[1]*Department of Microbiology, University of Peradeniya, Sri Lanka*
[2]*Department of Medical Laboratory Sciences, University of Jaffna, Sri Lanka*
[3]*Department of Pathophysiology, Faculty of Health Care Sciences, Eastern University, Sri Lanka*

[*]*siromi@univ.jfn.ac.lk*

Antimicrobial resistance (AMR) during pregnancy poses serious risks to maternal and neonatal health. Colonization with resistant organisms reflects community-level AMR and may contribute to neonatal sepsis through vertical transmission. Extended spectrum beta lactamase (ESBL)-producing Enterobacterales are significant due to their resistance to multiple beta-lactam antibiotics. This study aimed to detect common genetic markers of resistance in ESBL-producing Enterobacterales colonizing pregnant women and to identify associated maternal factors. Recto-vaginal swabs were collected from 235 pregnant women, and demographic and clinical data were obtained through an interviewer-administered questionnaire. Bacterial identification followed Cowan and Steel's manual. Screening for ESBL producers was conducted according to CLSI disc diffusion standards, and confirmation was done using the Double Disc Approximation Test (DDST) and Three-Dimensional Test (TDT). Multiplex PCR was used to identify *bla*CTX, *bla*TEM and *bla*SHV. The association between colonization with ESBL-producers and maternal factors was assessed by Chi-square test or Fisher's exact test using SPSS version 27.0. Among the selected Enterobacterales, *Escherichia* species (n=76), *Klebsiella* species (n=20) and *Enterobacter* species (n=15) were identified. Initially, 13 isolates were considered as phenotypically ESBL-producers. Among these, ten isolates (nine *Escherichia coli* and one *Klebsiella pneumoniae*) carried at least one of the three resistance genes. The overall colonization rate of ESBL producers in the study population was 4.3% (10/235). Among them, six *Escherichia coli* isolates were carried the *bla*CTX gene alone, two *Escherichia coli* isolates were carried the *bla*TEM gene alone, one *Escherichia coli* isolate carried both *bla*TEM and *bla*CTX, and one *Klebsiella pneumoniae* isolate carried all three resistance genes. Colonization with the selected ESBL producers was not associated with maternal factors studied including age (p=0.415), occupation (p=0.152) and monthly income (p=0.466). The predominance of *bla*CTX among colonizing isolates highlights the silent spread of ESBL genes in the community. Strengthening AMR surveillance and infection control measures during pregnancy is essential to mitigate maternal and neonatal risks and to inform strategies for preventing vertical transmission.

Keywords: *Antimicrobial resistance, esbl-producers, maternal factors, pcr*

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Knowledge of antibiotic use and resistance among non-medical students at a higher education institute in Kandy, Sri Lanka: A pilot study

K.G. Galahitiyawa[1], S. Jayasinghe[1], A. Surajdeen[1], R. Karunathilake[2], D.N. Balagalla[1,3*]

[1]*Department of Biomedical Science, ICBT Campus, Kandy, Sri Lanka*
[2]*Department of Microbiology, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*

[*]*dineeshanipuni@gmail.com*

Antibiotic resistance is a major public health crisis that could exacerbate into a pandemic. Understanding public perceptions of antibiotics is critical to design effective awareness programs, especially among the non-medical students. This study assessed the knowledge, attitudes, and practices related to antibiotic use and antibiotic resistance among non-medical students in Sri Lanka. A descriptive cross-sectional study was conducted using a pre-validated, self-administered questionnaire among the students at a Higher Education Institute in Kandy, Sri Lanka. Data on knowledge, attitudes, and practices regarding antibiotic use were collected and analyzed using descriptive statistics and non-parametric methods. Statistical analysis was performed using IBM SPSS Statistics 27. Overall, 197 participants were included in this study. The majority of the participants were females (68.5%) and were between the age group between 21 and 30 (24.9%). From the studied population, the majority (44.2%) were familiar with the term antibiotics. Majority (38.5%) were familiar with the term 'antibiotic resistance', majority (62.4%) incorrectly defined antibiotic resistance as the human body becoming resistant to antibiotics. The study cohort had a mean knowledge score of 68.91% (SD = 9.8). The mean knowledge score for gender was statistically significant ($p < 0.001$), with high knowledge mean score (70.3%) for females. Despite 61.9% claiming awareness of cough and cold causes, only 31.5% disagreed that "any antibiotic can cure cough and cold," revealing misconceptions. Among the participants 13.1% and 7.1% believed antibiotics are effective against viruses and fungi, respectively, while only 39.0% knew that antibiotics target bacteria. Although the knowledge in our study cohort was generally good, some misconceptions were evident. Thus, targeted education is needed to address knowledge gaps and encourage responsible antibiotic use among students. Therefore, recommendation ca be made to implement standardized procedures to bridge gaps between knowledge and practice to enhance positive attitudes and appropriate use of antibiotics.

Keywords: *Antibiotics, antibiotic resistance, knowledge, perception, practices*

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Bioactivity assessment of methanolic extract of *Murraya paniculata* and *Alpinia calcarata* plant leaves: Antioxidant, Cytotoxic, and Phytotoxic potential

R.H.V.C. Herath[1,2], H.A.K.D. Premasiri[1], K.G. Nelum Piyasena[1*], D.S. Jayaweera[1], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*University of Ruhuna, Matara, Sri Lanka*

[*] *nelum.pi@nifs.ac.lk*

Traditional medicinal plants are valuable sources of bioactive compounds with potential therapeutic and environmental applications. This study investigated the antioxidant, cytotoxic, and phytotoxic properties of methanolic leaf extracts from *Murraya paniculata (*Etteriya*)* and *Alpinia calcarata* (Araththa). *A. calcarata* and *M. paniculata* plants were selected due to their use in traditional Sri Lankan medicine for treating wounds, digestive disorders, and respiratory issues, suggesting the presence of bioactive compounds. This study provides insights into the bioactivity of these two plant species, adding to the limited data on their antioxidant and cytotoxic properties. Antioxidant capacity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and the Ferric Reducing Antioxidant Power (FRAP) assay. In the DPPH assay, *A. calcarata* exhibited stronger radical scavenging activity (IC_{50} = 68.58 ± 5.76 µg/mL) than *M. paniculata* (IC_{50} = 132.16 ± 10.45 µg/mL), although both were less potent than the positive control, ascorbic acid (IC_{50} = 7.90 ± 0.10 µg/mL). The differences observed between the two extracts were statistically significant ($p < 0.05$). FRAP values further supported the antioxidant potential, with *A. calcarata* and *M. paniculata* demonstrating values of 671.77 ± 21.25 and 578.46 ± 6.22 µmol Fe^{2+}/g, respectively, compared to Trolox (17679.67 ± 505.58 µmol Fe^{2+}/g). Cytotoxicity, evaluated via the brine shrimp lethality assay, indicated moderate toxicity, with LC_{50} values of 199.14 ± 17.51 µg/mL for *A. calcarata* and 168.17 ± 8.52 µg/mL for *M. paniculata* compared to the positive control potassium dichromate (LC_{50} = 7.97 ± 0.97 mg L^{-1}). Phytotoxicity analysis revealed no inhibitory effects on lettuce seed (*Lactuca sativa*) germination. Notably, *A. calcarata* extract appeared to promote seedling growth, indicating potential plant growth-stimulating properties. These findings suggest that both *M. paniculata* and *A. calcarata* possess notable antioxidant activity and moderate cytotoxic potential, supporting their relevance in pharmaceutical research. Additionally, the observed growth-promoting effects of *A. calcarata* warrant further investigation for possible agricultural applications. Continued studies are recommended to isolate and characterize the specific bioactive constituents responsible for these effects.

Keywords: *Bioactivity, DPPH, FRAP, lettuce seed germination*

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Pharmacological potential of *Ficus hispida* and *Pouteria campechiana* leaves: Exploring antioxidant, cytotoxic, and phytotoxic properties for therapeutic applications

K. Sylvester[1], H.A.K.D. Premasiri[1], K.G. Nelum Piyasena[1]*, D.S. Jayaweera[1], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

**nelum.pi@nifs.ac.lk*

Traditional medicinal plants are rich sources of biologically active compounds with valuable therapeutic potential. This study investigates the pharmacological properties of *Ficus hispida* (Kota dibula) and *Pouteria campechiana* (Lavulu) leaves, focusing on their antioxidant, cytotoxic, and phytotoxic activities. Methanolic extracts were prepared using sonication and rotary evaporation. Antioxidant activity was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and the Ferric Reducing Antioxidant Power (FRAP) assay. Cytotoxicity was assessed using the brine shrimp lethality assay, while phytotoxic effects were determined by seed germination in lettuce. The DPPH assay indicated moderate antioxidant activity, with IC_{50} values of 149.81 ± 15.04 µg mL^{-1} for *F. hispida* plant and 155.78 ± 40.97 µg mL^{-1} for *P. campechiana*, compared to ascorbic acid (IC_{50} = 7.90 ± 0.10 µg mL^{-1}) as the positive control. FRAP assay results supported these findings, showing FRAP values of 382.86 ± 12.59 µmol Fe^{2+}/g for *F. hispida* and 1494 ± 36.01 µmol Fe^{2+}/g for *P. campechiana*, relative to the positive control Trolox (17679.67 ± 505.58 µmol Fe^{2+}/g). Both extracts exhibited cytotoxic activity in comparison to $K_2Cr_2O_7$ (LC_{50} =7.97± 0.97 mg L^{-1}), with *F. hispida* demonstrating stronger activity with LC_{50} 100.54 ± 13.02 mg L^{-1} than *P. campechiana* LC_{50} = 672.42 ± 35.41 mg L^{-1}, suggesting greater cytotoxic potential. In the phytotoxicity test, *F. hispida* inhibited root and shoot growth by 46.73% and 15.44%, respectively. In contrast, *P. campechiana* showed a slight stimulatory effect, promoting root and shoot growth by 6.79% and 22.30%, respectively. Overall, both plant extracts demonstrated promising antioxidant and cytotoxic properties. These findings support their traditional medicinal uses and warrant further phytochemical and pharmacological investigation.

Keywords: *Brine shrimp lethality assay, DPPH assay, FRAP assay*

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Evaluation of *in vitro* and *in silico* antidiabetic activities of root extracts of *Psidium guajava* (guava)

W.S.M. De Silva [1], V.C.L. Hewage[1*], G.D.N. George[1], W. Weerasinghe[1]

[1]*Faculty of Life and Medical Sciences, BMS Campus, Colombo, 00600, Sri Lanka*

**visal.c@bms.ac.lk*

Psidium guajava, commonly known as guava, is widely recognized for its medicinal properties and has been traditionally used in management of diabetes. However, evidence on the antidiabetic potential of its root remains limited. This study aimed to evaluate the antidiabetic activity of *Psidium guajava* root extracts using *in vitro* and *in silico* approaches. Root extract was prepared using cold maceration with n-hexane, chloroform and methanol solvents. Antidiabetic activity was assessed through glucose adsorption capacity and glucose uptake by yeast cells, with Metformin being used as the positive control. Gas Chromatography-Mass Spectrometry (GC-MS) analysis was performed to identify bioactive compounds, which were subsequently subjected to molecular docking studies against α-amylase and α-glucosidase enzymes involved in carbohydrate digestion. Acarbose was used as the reference molecule in the docking studies. Each assay was performed in triplicates, and the results were analysed using one-way ANOVA followed by Tukey's post-hoc test using SPSS software to determine statistical significance ($p<0.05$). The methanol extract exhibited the highest glucose adsorption capacity, while the combined extract (n-hexane: chloroform: methanol, 1:1:1) showed superior glucose uptake by yeast cells (over 60%). GC-MS analysis identified three major compounds: lauric acid (dodecanoic acid), oleic acid (9-octadecenoic acid), and palmitic acid (n-hexadecanoic acid), abundantly present in n-hexane, chloroform and methanol extracts respectively. Molecular docking revealed that lauric acid formed two hydrogen bonds within the enzyme binding sites, indicating strong binding to both α-glucosidase (PLP fitness score: 49.89) and α-amylase (PLP fitness score: 47.08). Oleic acid showed the highest PLP fitness score (60.85) with α-glucosidase, while palmitic acid showed moderate binding affinity with both enzymes, suggesting potential inhibitory effects. *Psidium guajava* root extracts, particularly the methanol extracts, exhibited significant antidiabetic activity via glucose-binding mechanisms. Molecular docking confirmed strong interactions with key carbohydrate-metabolizing enzymes, supporting their traditional use and warranting further *in vivo* investigation.

Keywords: *Glucose adsorption, glucose uptake, lauric acid, metformin, molecular docking*

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Preliminary transcriptional evaluation of CXCL10 as a biomarker to identify latent tuberculosis infection

H.M.N.T. Bandara[1], D. Madegedara[2], I.U. Kumarage[1], R.M.K.M.K. Rathnayake[1], I. Rathnayaka[1], D.N. Magana-Arachchi[1*]

[1]*National Institute of Fundamental Studies, Sri Lanka*
[2]*National Hospital Kandy, Sri Lanka*

**dhammika.ma@nifs.ac.lk*

Tuberculosis (TB) remains a pressing global health concern, particularly due to the difficulty in distinguishing latent TB infection (LTBI) from active TB (ATB) and contact exposure. This study aimed to evaluate the transcriptional performance of CXCL10 as a potential biomarker to differentiate these TB states. CXCL10, also known as IP-10, is an interferon-gamma-inducible chemokine involved in immune cell trafficking and granuloma formation, making it a promising candidate in TB diagnostics. A selected cohort of 21 LTBI cases, 11 ATB cases, and 11 TB contactss was recruited following clinical examination, Tuberculin Skin Test (TST)/Mantoux testing. Peripheral blood samples were collected, total RNA was extracted using the phenol-chloroform method and reverse transcribed into cDNA using the Promega Reverse Transcriptase Kit. Quantitative PCR (qPCR) was conducted using B2M primers for internal validation and CXCL10 primers to assess gene expression differences among the groups. Gene expression normalization was performed using ΔCT values calculated as $CT_{B2M} - CT_{CXCL10}$. Negative ΔCT values were interpreted as relative downregulation of CXCL10. The average CT values for CXCL10 expression were 18.23±9.37 in LTBI, 22.96±1.96 in ATB, and 21.34±7.52 in contact. However, statistical analyses using both one-way ANOVA ($p = 0.4452$) and the non-parametric Kruskal–Wallis H-test ($p = 0.3180$) revealed no statistically significant differences in normalized CXCL10 expression between the study groups. These findings suggest that CXCL10 alone may not sufficiently discriminate between TB disease statuses within the limits of this study. While the observed transcriptional trends are biologically plausible, especially the tendency for higher CXCL10 expression in LTBI cases, they were not statistically conclusive. The limited sample size may have reduced the power to detect true differences. Hence, further investigations using larger and more diverse populations are recommended to determine the potential role of CXCL10 in transcriptional TB diagnostics.

Keywords: *Gene expression, latent infection, biomarker, qPCR, tuberculosis*

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In *silico* Analysis of *Drynaria quercifolia* bioactive compounds as potential inhibitors of Newcastle disease virus HN protein

K. Lakshan[1], A. Hasintha[1], H. Wijekoon[1], H. Adhikari[1], B. Manathunga[1], R. Nanayakkara[1], S. Poorni[1], D. Ariyasinghe[1], K.G.A. Samadhi[2], L. Ranathunga[1*]

[1]*Department of Animal Science, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*Standard Seed Corporation, United States*

[*]*lakmalr@agri.pdn.ac.lk*

Newcastle disease (ND), caused by avian paramyxovirus type 1 (APMV-1), is a highly contagious viral infection that severely impacts poultry operations globally, leading to significant economic and agricultural losses. In this study, we investigated the inhibitory effects of selected bioactive compounds derived from *Drynaria quercifolia* rhizome, with a specific focus on their interaction with the Newcastle disease virus (NDV) Hemagglutinin-Neuraminidase (HN) protein. D. *quercifolia* was selected because it is widely used in Asian traditional medicine and its rhizome contains proven antimicrobial and antiviral phytochemicals, making it a suitable candidate for NDV screening. The HN protein plays a critical role in recognising sialic acid receptors on host cells and facilitates membrane fusion during viral entry. A comprehensive literature survey identified 46 phytochemicals from *D. quercifolia*. These were assessed for pharmacokinetic properties using DataWarrior based on Lipinski's Rule of Five and toxicity filters, resulting in 45 candidates with drug-like. Virtual screening was performed using PyRx 0.8, and compounds with binding energies below -6 kcal/mol were prioritised. Among them, 9,19-cycloergost-24(28)-en-3-ol, 4,14-dimethyl-, (3β,4α,5α) demonstrated the strongest affinity with a binding energy of -8.3 kcal/mol and formed interactions with key residues including TYR262, TYR299, TYR317, PHE364, and TYR526. Docking with CB-Dock2 supported this result, showing a Vina score of -8.4 kcal/mol within a cavity volume of 500 $Å^3$. Complementary, the docking grid was centred at coordinates (-10, -50 -20) with a box size of 25 × 25 × 25 Å. Taken together, these results 9,19-cycloergost-24(28)-en-3-ol, 4,14-dimethyl-, (3β,4α,5α) derived from D. *quercifolia* show strong potential as an NDV inhibitor. Further molecular dynamics simulations, followed by in vitro and in vivo studies, are recommended to validate its therapeutic efficacy against NDV.

Keywords: *Hemagglutinin neuraminidase, newcastledisease, molecular docking, pharmacokinetic, molecular docking.*

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A study of the bioactivity potential of leaf extract of *Cissampelos pareira* grown in Sri Lanka

A.L.L. Wathsala[1], H.A.K.D. Premasiri[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk.*

Natural products continue to serve as an important source of bioactive compounds with significant medicinal properties. *Cissampelos pareira* (Diyamiththa), a climbing plant belonging to the Menispermaceae family, has been traditionally used in Sri Lanka for the treatment of various ailments, including bladder stones, scabies, abscesses, ulcers, wounds, and chronic cystitis. In this study, *C. pareira* leaves were collected from the Western Province of Sri Lanka, methanolic leaf extract was obtained from dried leaves and, evaluated for antioxidant, cytotoxic, and phytotoxic properties using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, FRAP (Ferric Reducing Antioxidant Power) assay, lettuce seed (*Lactuca sativa*) germination bioassay, and brine shrimp lethality assay. In the DPPH assay, *C. pareira* exhibited a moderate radical scavenging activity with an IC_{50} value of 28.45 ± 5.56 mg L^{-1}, which was lower than that of the positive control, ascorbic acid ($IC_{50} = 7.90 \pm 0.10$ mg L^{-1}). The FRAP assay revealed a relatively high reducing power (1215.91 ± 53.51 µmol $FeSO_4$ g^{-1} at 1000 mg L^{-1}), although this was still less than the Trolox standard (17679.67 ± 505.58 µmol $FeSO_4$ g^{-1}). In the phytotoxicity assay, the extract demonstrated growth-promoting effects, with negative inhibition percentages of -6.36 ± 1.01% for root growth and -16.98 ± 2.35% for shoot growth at 1000 mg L^{-1}. Seedlings treated with the extract showed increased average root and shoot lengths (1.50 ± 0.41 cm and 1.92 ± 0.27 cm, respectively) compared to the control group (1.41 ± 0.39 cm and 1.64 ± 0.22 cm). The brine shrimp lethality assay indicated low cytotoxicity, with an LC_{50} value of 196.47 ± 5.64 mg L^{-1}, substantially higher than the positive control, potassium dichromate ($LC_{50} = 7.97 \pm 0.97$ mg L^{-1}). Overall, the findings suggest that *Cissampelos pareira* possesses moderate antioxidant activity, low cytotoxicity, and plant growth-promoting effects. These results support its potential applications in both medicinal and agricultural fields and warrant further investigation into its bioactive constituents.

Keywords: *Antioxidant, phytotoxicity, cytotoxicity, bioactive*

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Rapid and precise identification of selected weed species in Sri Lanka using Bar-HRM analysis

D.T.S.V. Kumari[1], R.W.W.K.A.D. Rajapaksha[1], M. Saengthong[2], K. Buddhachat[2], N.U. Jayawardana[1], D.M.D. Yakandawala[3], V.N.S. Sirimalwatta[1*]

[1]*Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, 20400, Sri Lanka*
[2]*Department of Biology, Faculty of Science, Naresuan University, Thailand*
[3]*Department of Botany, Faculty of Science, University of Peradeniya, Sri Lanka*

**nipuni.siri@agri.pdn.ac.lk*

Invasive Weeds (IWs) pose a significant threat to global biodiversity and ecosystems. Increased movement among geographical regions has increased novel weed introductions. Plant Quarantine Service (PQS) regulates IWs movements in and out of the country, safeguarding agriculture and biodiversity. Traditional weed detection techniques based on germination tests are time consuming and require large samples. This study aimed to explore the possibility of using DNA barcoding with high-resolution melting (Bar-HRM) technique to develop an affordable, tailored molecular tool for rapid weed identification of Crotalaria juncea, Cyperus rotundus, Urochloa maxima, Panicum ripens, Mimosa pudica, M. pigra, Leucaena leucocephala, Cromolaena odorata, Sphagneticola trilobata, Lantana camara, Cuscuta reflexa, and Argyreia kleniana. Bar-HRM analysis was performed targeting *matK* and *rbcL* loci using EvaGreen® fluorescent dye on a BioRad RealTime PCR system. The characteristic melting temperatures (Tm) were determined within the range of 60 °C to 95 °C to monitor the complete DNA melting process, from fully double-stranded to completely denatured, which enabled reliable detection of sequence differences between species. Melting curves were obtained after normalizing the Tm values collected in every 0.1 ^{o}C interval. The targeted *rbcL* locus yielded overlapping melting curves for some species which may be attributed to close Tm values. The *matK*1 region distinguished 11 species while *matK*2 yielded distinct melting curves for all 12 species showing higher variation. Thus, *matK*1 and 2 have a greater discriminatory power than *rbcL*. Therefore, matK1 and matK2 markers are recommended for multi-species identification. Additionally, exploring more loci with high resolving power is worthwhile. In conclusion, Bar-HRM protocol offers rapid and differential detection of selected weed species. Implementing this tool can potentially reduce identification time, improve biosecurity measures, and facilitate trade by providing a faster and more reliable method for identification of selected weeds at NPQS.

Keywords: *DNA melting temperatures, invasive weeds, matk, rbcl*

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Formulation of alcohol-free herbal hand sanitizer and evaluation of its antibacterial effectiveness

D.R.N.L. Senevirathne[1*], K.G.N. Chandrasiri[1], S. Niroshan[1], I. Uluwaduge[2]

[1]*Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

[*]*nadunisenevirathne2000@gmail.com*

Alcohol-based hand sanitizers are widely recognized for their rapid antimicrobial action, but frequent use causes skin irritations, allergies, and respiratory issues. Therefore, non-alcoholic herbal hand sanitizers are considered a safer alternative. Growing concern over antibiotic resistance has further increased interest in plant-based antimicrobial agents. This study aimed to formulate an alcohol-free herbal hand sanitizer by using *Cinnamomum verum*, *Psidium guajava* L., *Aloe vera*, *Citrus aurantifolia*, *Jasminum officinale* essential oil, potassium sorbate, citric acid, and distilled water, and to evaluate its antibacterial activity, stability, user satisfaction, and efficacy of the product. A laboratory-based *in vitro* study was conducted. Dried powdered bark of C. *verum* and leaves of *P. guajava* L. were macerated with distilled water and concentrated using a rotary evaporator. Antibacterial activity of the extractions was assessed using the agar well diffusion method against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*. Minimum inhibitory concentration (MIC) values were determined, and extracts were combined with different ratios of *Aloe vera*, *Citrus aurantifolia*, and other components to prepare different combinations. The most effective combination was selected to formulate the sanitizer. The sanitizer was given to volunteers with a consent form, and feedback was collected through a structured questionnaire. Physicochemical properties (pH, colour, spreadability, odour) and antibacterial efficacy of the final product were evaluated over a period of one month. The combination of *C. verum* and *P. guajava* L. extracts in a 2:1 ratio exhibited significant antibacterial activity, especially against *S. aureus* (19 ± 0.58 mm inhibition zone), and moderate effects on *P. aeruginosa and E. coli*. The final product showed optimal pH (4.64), good spreadability (300%), and stable physical characteristics. Volunteer testing indicated a reduction in bacterial colony counts during post-application. The product demonstrated promising antibacterial activity, physicochemical stability, and presents as a skin-friendly and environmentally safer alternative to alcohol-based sanitizers. Further improvements may enhance its efficacy through extraction optimization and the addition of active compounds.

Keywords: *Antibacterial assay, formulation testing, hand sanitizer, minimum inhibitory concentration, plant extract*

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Evaluation of microbial contamination in commercially available talcum powders in Sri Lanka

A.N.N. Ariyarathna[1*], D.N.A.W. Samarakoon[1], M.F.F. Aneeka[1], N.A.S.A. Niyadagala[1], R.M.A.P.M. Rathnayake[1], W.P.D.P. Damishka[1]

[1]*KIU, Colombo, Sri Lanka*

[*] *b7b8057@kiu.ac.lk*

A common personal care item, talcum powder, includes microorganisms that can lead to skin infections and other health issues. Maintaining safety regulations and fostering consumer confidence in talcum powder products require routine quality control tests. The present study evaluates the microbiological quality of commercially available talcum powder brands from Sri Lanka to determine the extent of microbial contamination. The investigation was conducted on the contamination of different brands without generalizing all talcum powders available, and a sample size of 10 was taken and they were duplicated to validate the investigation. Samples were collected from unopened talcum powder bottle containers and prepared under sterile conditions. Microbiology techniques, including gram staining, culture on selective media, and biochemical tests have been done to identify bacterial and fungal contamination. The study found that bacterial growth was present in 35% of Talcum powder samples, while fungal growth was found in 35%, with Aspergillus spp. being detected in 5% out of 20 samples. Gram staining and biochemical analysis detected Gram-positive and Gram-negative bacteria with morphological types such as bacilli, cocci and diplococcobacilli. All contaminated samples demonstrated positive for catalase test. negative for urease, citrate, and indole tests. The study reveals environmental bacteria as the primary contaminants in talcum powder samples, necessitating molecular techniques for species identification and further research to identify potential health threats. The study discovered bacteria from environmental sources rather than clinically significant pathogens. Talcum powder manufacturing, distribution and storage need to implement strict quality control measures according to the findings. To guarantee consumer safety sterile testing practices along with stronger sterilization methods and regulatory guideline compliance need to be implemented regularly.

Keywords: *Bacteria, culture, fungi, pH, talcum powder*

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Comparison of the antimicrobial activity of *Melaleuca leucadendra* essential oil extracted in Sri Lanka with an imported *Melaleuca* essential oil

S.M.A. Upeksha[1], M.L.A.M.S. Munasinghe[1,2], E.A.B. Edirisinghe[3*]

[1]*Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Centre for Plant Materials and Herbal Products Research, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[3]*Bandaranaike Memorial Ayurveda Research Institute, Nawinna, Maharagama, Sri Lanka*

[*]*buddikae@gmail.com*

Melaleuca leucadendra (L.) (Lothsumbul) is a Myrtaceae plant which is native to Australia and introduced to Sri Lanka as an ornamental plant. The leaves of *M. leucadendra* produce an essential oil which has diverse bioactive properties including antimicrobial and anti-inflammatory. According to previous studies, *M. leucadendra* essential oil exhibits antimicrobial activity against fungi, Gram-positive and Gram-negative bacteria. The objective of this study is to investigate the antimicrobial activity of *M. leucadendra* leaf essential oil extracted in Sri Lanka against common human pathogens while compared it with imported *Melaleuca cajuputi* essential oil. The extraction of *M. leucadendra* essential oil was carried out using hydro-distillation. The antimicrobial activity of *Melaleuca* essential oils was checked with *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans* using the Kirby Bauer disk diffusion method. During the study, Chloramphenicol 10µg was used as a positive control for *E. coli* and *S. aureus*. Ketoconazole 30 µg discs were used for *C. albicans* as a positive control. An empty disc was used as a negative control. According to the results, *M. leucadendra* essential oil showed a higher inhibition zone (15.83 ± 0.03^{b} mm) against *E. coli* than *M. cajuputi* essential oil (9.67 ± 0.06^{a} mm) and also *M. leucadendra* essential oil showed a higher inhibition zone (19.33 ± 0.06^{b} mm) against *S. aureus* than *M. cajuputi* essential oil (16.17 ± 0.08^{a} mm). According to the results of the antifungal activity of essential oils, *M. leucadendra* essential oil showed a higher inhibition zone (12.33 ± 0.06^{b} mm) against *C. albicans* than *M. cajuputi* essential oil (7.67 ± 0.12^{a} mm). Based on the results of antimicrobial activity, both essential oils have shown antimicrobial activity against all tested pathogens but *M. leucadendra* essential oil has shown higher activity than *M. cajuputi* essential oil.

Note: The superscript letters (a, b) assigned indicate statistically significant differences ($p<0.05$) between the analyzed samples (n=3).

Keywords: *Hydro-distillation, inhibition zone, Melaleuca cajuputi*

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Investigating the synergistic effect of antibiotics with *Psychotria sarmentosa* (*Gonika*)

D.M.S.D.L. Dissanayake[1*], G.K. Lasanthika[1], R.M.S. De Silva[1], B.G.S.S. Bandara[1], R. Thajenthini[1], U.L.R.M. De Silva[1], Y.P. Nandapala[1]

[1]*Faculty of Health Science, KIU*

[*]*suminighs1604@gmail.com*

Antibiotic resistance is a major global health challenge, prompting the search for alternative strategies to enhance antimicrobial effectiveness. This study investigates the bactericidal and antibiotic-potentiating properties of the ethanol leaf extract of *Psychotria sarmentosa* (Gonika), a Sri Lankan medicinal plant traditionally used for treating infections. The aim was to evaluate its individual antibacterial activity and its synergistic potential when combined with Vancomycin and Gentamicin against *Staphylococcus aureus* (Gram-positive) and *Escherichia coli* (Gram-negative). The experimental work was conducted at the Biomedical Science Laboratory, KIU Campus, Sri Lanka. Leaves of *P. sarmentosa* were collected, washed, dried, ground, and subjected to ethanol extraction. The antimicrobial activity was tested using standard broth dilution and subculturing methods to determine Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC). Synergistic effects were assessed by combining a fixed sub-inhibitory dose (0.125 µg ml^{-1}) of each antibiotic with varying concentrations of the extract, and results were analysed using the Fractional Inhibitory Concentration Index (FICI). The extract showed bactericidal activity with MBC values of 15.6 mg ml^{-1} against *S. aureus* and 125 mg ml^{-1} against *E. coli*. Vancomycin and Gentamicin were effective at 2 µg ml^{-1} and 1 µg ml^{-1}, respectively. In the presence of a sub-inhibitory concentration of the respective antibiotic, the MBC of the *P. sarmentosa* extract against both bacterial strains was reduced to 7.8 mg ml^{-1}. FICI analysis revealed an additive effect with Vancomycin (FICI = 0.5625) and a synergistic effect with Gentamicin (FICI = 0.1874). All the experiments were carried out in duplicate, and mean values were used for FICI calculation. These findings suggest that *P. sarmentosa* extract can enhance antibiotic efficacy, potentially enabling lower antibiotic doses, reducing side effects, and delaying resistance development. This highlights the potential of plant-based adjuvant therapies, especially in low-resource settings.

Keywords: *Escherichia coli, fractional inhibitory concentration index, gentamicin, Staphylococcus aureus, vancomycin*

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Comparative analysis of *Solanum torvum* and aspirin in attenuating heat-induced hemolysis: Implications for natural anti-inflammatory drug development

K.M.N.S. Muhandiram[1], Y.M.U.Y. Bandara[1*]

[1]*NSBM Green University, Pitipana, Homagama, Sri Lanka*

[*]*udeshika.y@nsbm.ac.lk*

Inflammation is a defensive response that occurs in the vascular tissue of the body, often triggered by various pathophysiological processes. Although Non-Steroidal Anti-inflammatory Drugs (NSAIDs) are used to manage inflammation, their long-term use is associated with several serious side effects. Hence, plant-based alternatives are being explored as safer therapeutic options. However, scientific evidence supporting the anti-inflammatory potential of *Solanum torvum*, particularly through erythrocyte membrane stabilization, remains limited. This study specifically aimed to evaluate and compare the membrane-stabilizing potential of aqueous leaf extract of *Solanum torvum* with that of aspirin against heat-induced hemolysis in human erythrocytes. The inhibitory effects on erythrocyte membrane lysis under heat stress (56 ℃, 30 min) were assessed at different concentrations ranging from 0.1 to 3mg/mL. The well-known anti-hemolytic capabilities of aspirin was confirmed by its significant, dose-dependent inhibition (10.35% to 35.26%) with minimal variability (1.31±0.66). *Solanum torvum* extract also showed concentration-dependent inhibition, reaching a maximal inhibition of 25.22% at 1.5 mg/mL, though with higher variability (4.77±1.31). Notably, the plant extract (18.70%) demonstrated comparable effectiveness to aspirin (18.05%) at 1mg/mL, indicating the presence of bioactive substances contributing to membrane stabilization. These findings suggest that *Solanum torvum* is a promising natural remedy for mitigating erythrocyte membrane damage and potentially alleviating inflammation. Further research studies are needed to isolate and characterize the active compounds responsible for this activity.

Keywords: *Anti-hemolytic, dose-dependent inhibition, inflammation, membrane stabilization, natural therapeutics, Solanum torvum*

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Comprehensive evaluation of chemical and pharmacological profiles of essential oils extracted from *Garcinia quaesita, Neolitsea cassia* and *Lasia spinosa*

M.N.V.C. Fernando[1], V.P. Bulugahapitiya[1*], S. Kokilananthan[2]

[1]*University of Ruhuna, Matara, Sri Lanka*
[2]*The Open University of Sri Lanka, Batticaloa, Sri Lanka*

**vajira@chem.ruh.ac.lk*

Essential oils (EOs) have been used as natural remedies for centuries due to their diverse therapeutic properties. However, only a few studies have explored the chemical composition and pharmacological profiles of multiple EOs derived from medicinal plants in Sri Lanka. This study aimed to compare the chemical composition and evaluate antioxidant, antifungal, antidiabetic, and insect-repellent activities of EOs extracted from leaves of native and endemic plants, *Garcinia quaesita* (GQ), *Neolitsea cassia* (NC) and *Lasia spinosa* (LS). EOs were extracted using the hydro-distillation method and characterized by gas chromatography-mass spectroscopy (GC-MS), considering only those chemical compounds with a matching value greater than 90%. The antioxidant potential (AP) of each EO was evaluated using Ferric Reducing Antioxidant Power assay and the 2,2-diphynyl-1-picrylhydrazyl (DPPH) radical scavenging assay. Antifungal activity was evaluated by recording the number of days required for visible fungal growth on fruits or vegetables stored at room temperature. Antidiabetic activity (in vitro) was assessed by calculating the percentage increase in glucose uptake by yeast cells. Insect repellent efficacy was determined through behavioral assays conducted against mosquitos and termites. The results showed that the percentage yield of EO was 0.11±0.0053% (v/w) for GQ while 0.033±0.0037% (v/w) for NC, and 0.027±0.0048% (v/w) for LC respectively. Chemical compounds that were identified in the each EO were mainly sequiterpenes, and copaene, (-)-α-gurjunene, caryophyllene, α-humule, alloaromadendrene, β-maaliene, δ-cadinene, nerolidol, (-)-globulol, α-cubebene, β-cubebene, and α –farnesene were prevalent. LS EO had the highest antioxidant potential (183.08 µmol $FeSO_4.7H_2O$ Eq/L) and glucose uptake increase by yeast cells (96.95%). NC EO exhibited the highest (66.7%) percentage of termite repellency while GQ EO had the greatest (63.3%) percentage of mosquito repellency. As a comprehensive analysis, these findings disclose the correlations between chemical composition and pharmacological activities of studied EOs and ensure their potential applications in medicine, agriculture and food industries.

Keywords: *Antidiabetic, antifungal, antioxidant, insect repellency*

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Antioxidant and antidiabetic activities of hot water extracts of unripe *Musa paradisiaca* and *Doona macrophylla* Thwaites

U.I. Hettiarachchi[1,2,3], H.A.K.D. Premasiri[1], M.T. Napagoda[3], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Genetics and Molecular Biology Unit, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*
[3]*Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Musa paradisiaca (ash plantain), a member of the Musaceae family, has been utilized as a food source and in traditional medicinal practices across various cultures. *Doona macrophylla* Thwaites (maha beraliya) is an endemic flowering plant to Sri Lanka. This study primarily aims to evaluate the biological activities of the edible parts of *M. paradisiaca* and *D. macrophylla*, as current literature offers limited data on their bioactivity when consumed in forms consistent with traditional dietary practices. The fresh edible parts of *M. paradisiaca* and the dried seeds of *D. macrophylla* were washed, cut, or ground, then boiled with hot water at 100 °C for 15 minutes in a hot water bath and freeze-dried. The antioxidant properties of crude extracts were determined by *2,2-diphenyl-1-picrylhydrazyl* (DPPH) radical scavenging and Ferric Reducing Antioxidant Power (FRAP) assays. The assays were conducted in a concentration range of 31.25 – 1000 mg L^{-1}. According to the DPPH assay results, *M. paradisiaca* peel (IC_{50} 29.928±11.431 mg L^{-1}) and *D. macrophylla* (IC_{50} 32.88±2.98 mg L^{-1}) showed strong antioxidant activity, while *M. paradisiaca* fruit (IC_{50} 1542.10±131.63 mg L^{-1}) had weak antioxidant activity compared to the positive control, ascorbic acid (IC_{50} 7.90×10^{-3}±0.10 mg L^{-1}). In the FRAP assay, all the crude extracts: *M. paradisiaca* peel ($7.64\pm0.11\times10^3$ µmol Fe^{2+}/g), fruit ($5.32\pm0.17\times10^3$ µmol Fe^{2+}/g), inflorescence ($6.54\pm0.19\times10^3$ µmol Fe^{2+}/g), and *D. macrophylla* ($7.00\pm0.10\times10^3$ µmol Fe^{2+}/g) exhibited bioactivity compared to the positive control, Trolox ($17.68\pm0.51\times10^3$ µmol Fe^{2+}/g). The antidiabetic potential was evaluated using the α-amylase inhibition assay at 1000 mg L^{-1}. The highest percentage inhibition was observed in *M. paradisiaca* fruit (69.09±3.07%), while *M. paradisiaca* peel (67.96±7.81%) and *D. macrophylla* (64.41±3.72%) exhibited bioactivity compared to acarbose (57.51±4.33%). In conclusion, *M. paradisiaca* peel showed strong, and fruit showed weak antioxidant potential as evidenced by DPPH and FRAP assays. All crude extracts showed inhibition potential against the α-amylase enzyme at 1000 mg L^{-1}.

Keywords: *α-amylase inhibition, bioactivities, DPPH, food, frap*

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Free radical scavenging and anti-inflammatory activities of the extracts of *Lentinula edodes* (Shiitake Mushroom)

D.K.S.P. Dikkumbura[1], G.L.M. Thathsarani[1], A.N. Ediriweera[2], A.I. Kuruppu[3], S.P.N.N. Senadeera[4], C.B. Ranaweera[1*]

[1]*Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Colombo, Sri Lanka*
[2]*B-Hood Mycotropic Innovations, Issadeen Town, Matara, Sri Lanka*
[3]*The Institute for Combinatorial Advanced Research and Education, General Sir John Kotelawala Defence University, Colombo, Sri Lanka*
[4]*Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Sri Lanka*

**cbr2704@kdu.ac.lk*

Lentinula edodes, (Shiitake mushroom), is a widely consumed edible fungus with nutritional and medicinal value. It contains high concentrations of bioactive compounds, although, research on its therapeutic properties is limited. With prevalence of chronic and non-communicable diseases, exploration of natural therapeutic agents holds importance as pharmacological treatments are expensive and associated with side effects. This study aimed to evaluate the *in vitro* antioxidant and anti-inflammatory activities of aqueous, methanol, dichloromethane, and hexane extracts prepared from fruiting bodies of *L. edodes*. Serial doubling dilutions of the extracts (15.625–2000 µg/mL) were prepared in distilled water for the assays. Total phenolic content (TPC) was determined and antioxidant activity, was evaluated by 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) assays. Anti-inflammatory activity was evaluated using egg albumin denaturation and human red blood cell (HRBC) membrane stabilization assays. Each assay was performed in triplicate (n=3), and results were expressed as mean ± SD. IC_{50} values were determined by nonlinear regression (four-parameter logistic model) using GraphPad Prism(V10). The aqueous extract exhibited the highest total phenolic content. DPPH assay, the hexane extract showed the strongest antioxidant activity (IC_{50} of 190.3 µg/mL) compared to the standard, butylated hydroxytoluene (BHT) (IC_{50} = 55.17 µg/mL). ABTS assay, the methanolic extract exhibited the highest activity (IC_{50} = 193.9 µg/mL), compared to BHT (IC_{50} = 104 µg/mL). Results obtained in ABTS assay is supported by the high phenolic content revealed in TPC assay for methanolic extract. These results suggest that *L. edodes* possesses both hydrophilic and lipophilic antioxidant compounds. In anti-inflammatory activity, hexane extract showed the strongest inhibition of protein denaturation with an IC_{50} of 99.81 µg/mL, outperforming the standard diclofenac sodium (IC_{50} = 376.7 µg/mL). The aqueous extract exhibited the highest HRBC membrane stabilization (IC_{50} = 127.2 µg/mL), also surpassing diclofenac sodium (IC_{50} = 197.5 µg/mL). In conclusion, *L. edodes* demonstrated notable antioxidant and anti-inflammatory properties across various solvent extracts supporting its potential as a natural therapeutic agent.

Keywords: *antioxidant activity, egg albumin denaturation, human red cell membrane stabilization assay*

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A natural brew: Scientific insights into the bioactivity of a traditional herbal tea

P.A. Sewwandi[1], A.I. Kuruppu[1*]

[1]*Institute for Combinatorial Advanced Research and Education, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*

**kuruppua@kdu.ac.lk*

Sri Lanka is globally renowned for its high-quality teas derived from *Camellia sinensis*. In addition to these well-known varieties, the country is also home to a diverse range of herbal teas that, although less widely recognized, possess remarkable health-promoting properties. These herbal infusions, prepared from various parts of medicinal plants such as leaves, flowers, fruits, and bark, have long been utilized in traditional medicine for their therapeutic benefits. Among them, tea made from *Osbeckia octandra* holds particular significance. This plant, with a long history of use in Sri Lankan traditional medicine, is reputed for its effectiveness in managing liver disorders, diabetes, and hyperlipidemia. Despite its extensive ethnomedicinal background, proper scientific validation confirming its medicinal properties remains limited. Therefore, the current study mainly focuses on investigating the bioactivity of the commercially available Sethsuwa *Osbeckia octandra* herbal tea, which is made of dried plant leaves, by evaluating its phytochemical profile, antioxidant capacity, and cytotoxic effects through *in vitro* bioassays, thereby reinforcing its potential as a functional natural product. The total phenolic content (TPC) of the raw tea powder was determined using the Folin-Ciocalteu method and was found to be 26.43 mg gallic acid equivalents (GAE) per gram. The total flavonoid content (TFC), estimated using the aluminium chloride colorimetric assay, was comparatively lower, measured at 0.736 mg quercetin equivalents (QE) per gram. Despite its relatively low flavonoid content, the raw tea powder demonstrated potent antioxidant activity, with the DPPH radical scavenging assay showing a maximum inhibition of 85.50% at a concentration of 1 mg/mL. In comparison, Butylated Hydroxytoluene (standard) exhibited a maximum inhibition of 82.31% at the same concentration. The cytotoxicity of the tea extract, evaluated using the MTT assay on Vero cells, indicated a cell viability of 49.16% at 1 mg/mL. These results suggest that the herbal tea exhibits notable antioxidant potential, likely associated with its phenolic constituents. Further studies are recommended to investigate its additional bioactivities, such as anti-inflammatory activity, through additional *in vitro* experiments.

Keywords: *Antioxidant activity, bioactive compounds, herbal teas of sri lanka*

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Valorization of rubber wood waste for the sustainable cultivation of *Lentinus squarrosulus* and authentication via morpho-molecular tools

M.V.S. Indrakeerthi[1], R.M.C.S. Ratnayake[1*], D.A.D.A. Daranagama[1]

[1]*Department of Plant and Molecular Biology, Faculty of Science, University of Kelaniya, Sri Lanka*

[*]*ratna@kln.ac.lk*

Despite its recognised nutritional and medicinal value, the domestication and commercial cultivation of *Lentinus squarrosulus* remain underexplored. This study aimed to assess rubber sawdust as a viable substrate for fruiting body production of *Lentinus squarrosulus* through combined spawn development approaches and morpho-molecular identification. Each substrate was supplemented with rice bran (10%), calcium carbonate ($CaCO_3$) (2%), and magnesium sulphate ($MgSO_4$) (0.2%). The mixture (500g per bag) was filled into 500-gauge polypropylene bags and autoclaved. Each Bag was inoculated with 2 g from the 10-day-old mycelial culture and incubated under dark conditions at room temperature. Morphological analysis was conducted on 10 wild and 10 cultivated *Lentinus squarrosulus* fruiting bodies, including cap diameter, lamella coloration, stipe height, and spore dimensions. Molecular identification was performed through amplification and sequencing of the internal transcribed spacer (ITS) region of ribosomal DNA, followed by the Maximum Likelihood phylogenetic analyses, confirming the identity of the collected isolates. The wild specimens exhibited basidiocarps ranging from whitish to greyish, with prominent squamules on the surface. The cap was lamellate, with deeply decurrent lamellae, and the stipe measured 2–5 cm in height and 2–5 mm in diameter, occasionally presenting a subbulbous base. Spores were whitish, cylindrical, ranging from 5.5–6.7 µm in length and 1.5–2.5 µm in width. The cultivation substrate, consisting of rubber sawdust enriched with rice bran, facilitated robust mycelial colonisation, with fruiting bodies developing 90 days of post-inoculation. Based on amplification and sequencing of the ITS region of ribosomal DNA, molecular identification confirmed that the collected isolate was positioned within a well-supported clade of *L. squarrosulus* with 68% bootstrap support, indicating a close genetic relationship with other Asian strains. Cultivated fruiting bodies exhibited phenotypes consistent with wild types, validating successful domestication through corn seed spawning on rubber sawdust. This sustainable, low-cost approach optimises wood waste and advances Sri Lanka's food security.

Keywords: *ITS, phylogeny, taxonomy, wild edible mushroom*

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Standardisation and chemical profiling of bioactive compounds in *Senna spectabilis* leaves: An underutilised medicinal plant in Sri Lanka

R.A.H.M.S.T. Abeyrathne[1], E.A.B. Edirisinghe[2*], G.D. Sinniah[1]

[1]*Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*
[2]*Pharmaceutical Botany Division, Bandaranaike Memorial Ayurveda Research Institute, Sri Lanka*

[*]*buddikae@gmail.com*

The standardisation of medicinal plants used in traditional medicine is increasingly important due to the growing commercialisation of plant-based formulations. In this study, an attempt was made to standardise *Senna spectabilis* leaves based on morphological, microscopic, chromatographic, and chemical profiling parameters to authenticate and identify the major chemical constituents. Macroscopic and microscopic investigations confirmed taxonomically significant characteristics in *S. spectabilis*, including its pinnately compound leaves, yellow flowers, and dicot leaf anatomy with unbranched trichomes and a collateral vascular bundle. Thin-layer chromatography profiles of *S. spectabilis* leaf hexane extracts from Kandy, Welimada, and Bibile showed similar band separation patterns, supporting their chemical similarity, and confirming that they belong to the same species. Gas chromatography-mass spectrometry analysis detected 34 phytochemical compounds in the *S. spectabilis* leaf methanol extract, including one notable compound identified as (-)-Cassine. It exhibits anti-inflammatory and anti-hyperalgesic effects in both acute and chronic pain models. A compound n-Hexadecanoic acid is known for its anti-inflammatory activity. Octadec-9-enoic acid showed a range of biological activities, including anti-inflammatory and antiandrogenic. 2-Bromo dodecane has been reported to exhibit antibacterial activity, suggesting the potential existence of bioactive compounds of therapeutic potential. This study successfully standardised *S. spectabilis* leaves through morphological, anatomical, and chromatographic analyses, confirming their authenticity and chemical consistency across regions. GC-MS profiling further identified key bioactive compounds, providing a foundation for future pharmacological investigation.

Keywords: *Authenticate, gas chromatography-mass spectrometry, morphological, pharmacological, thin layer chromatography*

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Co-occurrence of TP53 R248Q and PIK3CA hotspot mutations in a Sri Lankan breast cancer cohort

C.D.G. Prabodhya[1], L.L.T.R. Cabraal[2], I. Kumarasinghe[2], R. Perera[2], J. Balawardana[2], N. Perera[3], C.B. Ganegoda[3], G.H. Galhena [1*]

[1]*Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Sri Lanka,*
[2]*University Hospital, General Sir John Kotelawala Defence University, Sri Lanka,*
[3] *Genentech Molecular Diagnostics, Sri Lanka*

[*]*gayani@zoology.cmb.ac.lk*

The *TP53* and *PIK3CA* genes are among the most frequently mutated in breast cancer (BC), with their co-occurrence increasingly associated with aggressive Tumour behaviour and poorer prognosis. This study investigated the co-occurrence of the TP53 R248Q hotspot mutation and three common PIK3CA mutations (E542K, E545K, and H1047R) in a Sri Lankan BC cohort. DNA from formalin-fixed, paraffin-embedded breast tumour samples (n=45; HER2-positive = 23, HER2-negative = 22) was analyzed for the TP53 R248Q mutation. The cohort, selected by convenient sampling, included tumours with known PIK3CA mutation status (E542K = 2, E545K = 4, H1047R = 14, and both H1047R + E545K = 1). PCR amplification of a 123 bp region flanking the mutation site was carried out using in-house designed primers (forward:5'-CAAGTGGCTCCTGACCTGG-3'; reverse:5'-TGGCTCTGACTGTAC CACCA-3') and GoTaq Flexi DNA Polymerase. Amplicons were visualized on 3% agarose gels and subjected to automated Sanger sequencing. Sequence alignment and variant detection were performed using MEGA 7.0.1.4. A single sample (2.2%) was found to harbour the TP53 R248Q mutation, consistent with the prevalence reported in other Asian populations. Notably, this sample also carried the PIK3CA H1047R mutation and exhibited a HER2- positive, ER/PR-positive phenotype with low proliferation (Ki-67: 10%). This pilot study provides the first evidence of TP53 R248Q and PIK3CA H1047R co-mutation in a Sri Lankan BC cohort. Given the known implications of TP53 gain-of-function mutations and PIK3CA activation in treatment resistance, co-mutation profiling may offer added value for therapeutic responses in this subgroup.

Keywords: *Co-mutation, common mutation, H1047R, HER2-positive, p53 mutation*

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A comparative analysis of *Rhinacanthus polonnaruwensis* leaf constituents: Chromatographic fingerprinting and fluorescence properties across solvent extracts

H.M.A.A. Herath[1], E.A.B. Edirisinghe[2*], P.K.C.B. Wijerathne[1]

[1]*University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Bandaranayike Memorial Ayurveda Research Institute, Maharagama, Sri Lanka*

[*]*buddikae@gmail.com*

Rhinacanthus polonnaruwensis L.H. Cramer is an endemic plant of Sri Lanka, locally known as "*Heen Aniththa*". Belonging to the genus *Rhinacanthus* within the family Acanthaceae, it shares a close phylogenetic relationship with *Rhinacanthus nasutus* (L.) Kurz, a species extensively studied for its phytochemical content, particularly naphthoquinones, known for their therapeutic potential. In contrast, *R. polonnaruwensis* has received minimal scientific attention. This study aims to assess the phytochemical composition of *R. polonnaruwensis* leaves using different extraction solvents—hexane, ethyl acetate, and methanol. Preliminary phytochemical and thin-layer chromatographic analyses were conducted on the extracts, while fluorescence examination was performed by treating leaf powder with different reagents (water, methanol, hexane, chloroform, 50% nitric and 50% sulphuric) to detect chemical compounds under visible and UV light. Phytochemical screening revealed that alkaloids, tannins, and phenolic compounds were present in all tested solvent extracts. TLC analysis revealed distinct banding patterns for each extract, with the ethyl acetate extract showing a broader range of phytoconstituents, displaying five spots under daylight and 365 nm and four spots under 254 nm. Fluorescence analysis of the plant powder and reagents revealed distinct colour changes under UV light, indicating diverse phytochemicals. Chloroform and methanol with leaf powder showed red fluorescence at 366 nm, suggesting flavonoids or phenolic compounds, while hexane and acid-treated samples exhibited black fluorescence at 254 nm, likely due to non-polar or strongly oxidising components. The water treated leaf powder consistently showed blue fluorescence at 366 nm, supporting the presence of fluorescent secondary metabolites. These findings provide a basic scientific foundation for more in-depth phytochemical and pharmacological research on this indigenous plant.

Keywords: *Endemic, medicinal plants, phytochemical, thin layer chromatography*

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Preliminary investigation of *Monoon longifolium* bark: Phytochemical screening, TLC profiling and fluorescence characterisation

S.H. Nimasha[2*], E.A.B. Edirisinghe[1], G.D. Sinniah[2]

[1]*Bandaranaike Memorial Ayurveda Research Institute, Nawinna, Maharagama, Sri Lanka*
[2]*University of Sri Jayewardenepura, Gangodawila, Nugegoda, SriLanka*

[*]*shnimasha99@gmail.com*

Monoon longifolium (Sonn.) B. Xue & R.M.K. Saunders, belonging to the family Annonaceae, is commonly recognised for its ornamental appeal and traditional medicinal applications. The bark of *M. longifolium* has been used in herbal medicine, though it remains scientifically underexplored compared to its leaves. This study aimed to evaluate the presence of bioactive compounds such as alkaloids, flavonoids, tannins, terpenes and phenolic compounds in the bark of *M. longifolium*, using two solvent extractions and chromatographic techniques, along with determining its physicochemical parameters for quality control. Preliminary phytochemical studies including Iodine, Ammonia, Braymer's, Copper acetate, and ferric chloride tests along with thin layer chromatography were conducted on both ethanol and ethyl acetate macerated extractions. Fluorescence examination of bark powder under visible and UV light (365nm, 254nm) was performed to identify characteristic compound responses. Physicochemical analysis assessed moisture content via the loss on drying method and measured extractable matter using ethanol and ethyl acetate extractions. Phytochemical screening revealed that the ethanol extract contained alkaloids, flavonoids, tannins, terpenes, and phenolic compounds, while the ethyl acetate extract revealed flavonoids and phenolic compounds. The TLC profile of the ethanol extract revealed black (R_{f1}= 0.33), blue (R_{f2} = 0.54), yellow (R_{f3} = 0.63), and white (R_{f4} = 0.71). In contrast, ethyl acetate extract exhibited blue (R_{fa} = 0.56), purple (R_{fc} = 0.792), and black (R_{fd} = 0.85), confirming the presence of compounds in each extract. Fluorescence tests further validated the presence of these compounds and offer a simple, cost-effective method for rapid screening. Physicochemical analysis showed moisture content by dry weight of the bark sample of 11.06 ± 0.09%, an ethanol-soluble extractive value of 10.02 ± 0.54% and ethyl acetate soluble extractive value 7.07 ± 0.07%. These results demonstrated that the bark of *M. longifolium* is a rich source of medicinally valuable phytochemicals and exhibits stable physicochemical properties, emphasising its potential in herbal medicine.

Keywords: *Bioactive compounds, ethanol, fluorescence, underexplored*

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Biodegradation of synthetic textile dyes using a cyanobacterial co-culture

S.W.M.R.M.P.R. Udalagama[1], W.A.Y.B.S. Weeraarachchi[1], K.M.S.D. Wijerathne[1], R.M.C.P. Kumari[1], S.M.D.C. Bandara[1], R.R. Ratnayake[1*]

[1]*National Institute of Fundamental Studies (NIFS), Kandy, Sri Lanka*

**renuka.ra@nifs.ac.lk*

Textile wastewater contains recalcitrant synthetic dyes which should be properly treated before releasing to the environment. This study investigated the degradation potential of a combined culture of CB3-CB5 against Rhodamine-B and reactive blue dye. CB3 and CB5 are filamentous cyanobacterial strains isolated from freshwater bodies in Sri Lanka. A total of 3 mL of each strain was inoculated into 150 mL of 10 ppm dye solutions prepared using sterilized tap water within 250 mL erlenmeyer flasks. The cultures were maintained under continuous illumination (2000-3000 lux) and ambient laboratory conditions for 28 days, with daily manual shaking of two times. Cyanobacterial growth and dye decolorization were monitored twice a week using a UV-spectrophotometer at 680 nm for growth and at λmax values of 563 nm Rhodamine-B and 616 nm blue dye for decolorization. After 28 days, biomass was harvested by centrifugation at 3000 rpm for 10 mins and oven-dried to obtain the final dry cell weight. The CB3-CB5 co-culture exhibited significantly higher decolorization efficiency for blue dye (74.8%) compared to Rhodamine-B (3.7%). Biomass productivity was observed as 0.67 mg/day and 0.33 mg/day in the blue dye and rhodamine-B, respectively. A toxicity assay using mung bean seeds (*Vigna radiata*) confirmed reduced dye toxicity after treatment. In the co-culture treated Rhodamine-B sample, the average root and shoot lengths were recorded as 5.87 ± 1.4 cm and 5.47 ± 1.9 cm, respectively, whereas for the blue dye, they were recorded as 4.28 ± 2.8 cm and 3.87 ± 1.7 cm, respectively, compared to their control. These results indicate the effective detoxification of the selected dyes by the cyanobacterial co-culture. The lower decolorization of Rhodamine B was attributed to its recalcitrant xanthene ring structure. Overall, CB3-CB5 co-culture exhibited its potential for biodegradation of synthetic textile dyes, particularly those with simpler molecular structures.

Keywords: *Decolorization, eco-remediation, filamentous strains, phytotoxicity, rhodamine*

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Novel conceptual design of a CRISPR-based genetic circuit targeting carbapenemase genes in *Enterobacteriaceae* to reverse antibiotic resistance

D.N. Karunathilake[1], D.C. Manatunga[1*], W.R.M. De Silva[2,5], K.M. Nalin De Silva[2], D.M.B. Thushari Dissanayake[3], A.H.L. Renuka Nilmini Liyanage[4], Rohan S. Dassanayake[1], K.K. Asanka Sanjeewa[1], H.M.L.P.B. Herath[5], J.R.P. Jayasingha[2,6]

[1]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka,*
[2] *Centre for Advanced Materials and Devices (CAMD), Department of Chemistry, University of Colombo, Sri Lanka,*
[3]*Faculty of Medicine, University of Sri Jayewardenepura, Nugegoda, Sri Lanka,*
[4]*Department of Materials and Mechanical Technology, Faculty of Technology, University of Sri Jayewardenepura, Homagama, Sri Lanka,*
[5]*National School of Business Management, Homagama, Sri Lanka,*
[6]*Department of Medicine, University of Melbourne, Parkville, Australia*

**danushi@sjp.ac.lk*

Carbapenemases hydrolyze β-lactam ring-containing antibiotics while rendering even the last antibiotic line, carbapenems, ineffective. This study aimed to design the first theranostic CRISPR-based tool for carbapenem resistance reversal. Literature was reviewed to find the prevalent carbapenemase gene families. Target gene sequences were retrieved from NCBI, GenBank and β-Lactamase Database. Sequences (399) were aligned via Clustal Omega. gRNAs were designed for *blaOXA-48-like*, *blaKPC*, and *blaNDM* using the CHOPCHOP tool for each gene family followed by off-target analysis on *Escherichia coli* BL21 and mutation efficiency predictions. The plasmid was designed on SBOL Design using a gRNA-tRNA array and genetic parts retrieved from publications/ registries (iGEM and Synbiohub), including promoter/ operator regions, ribosome binding sites, coding sequences and terminators. Benchling software was used for visualization. The circuit is triggered by ampicillin and carbapenemase. AmpR promoter produces TetR that inhibits gRNA and GFP expression by binding to TetO sites. When a carbapenem-resistant pathogen is present, it produces carbapenemase which hydrolyzes Ampicillin and reduces its intracellular concentration. This turns on gRNA and eGFP expression as TetR is absent. A high conservation rate (>90%) was observed within families. gRNAs exhibited high frameshift frequencies (>60%) while being complementary to gene locations of enzyme active sites with zero off-target effects, suggesting maximal disruption. The circuit is potentially effective against carbapenem-resistant bacteria. Experimental validation is yet to confirm circuit functionality. Limitations include overcoming other resistant strategies such as active antibiotic efflux.

Keywords: *Beta lactamases, bla genes, carbapenem resistance, CRISPR, guide RNA.*

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Bioremediation of reactive blue textile dye using a filamentous cyanobacterial strain

K.M.S.D. Wijerathne[1], S.W.M.R.M.P.R. Udalagama[1], W.A.Y.B.S. Weeraarachchi[1], R.M.C.P. Kumari[1], S.M.D.C. Bandara[1], R.R. Ratnayake[1*]

[1]*National Institute of Fundamental Studies (NIFS), Kandy, Sri Lanka*

[*]*renuka.ra@nifs.ac.lk*

The continuous discharge of synthetic textile dyes into aquatic ecosystems presents significant environmental and public health challenges, necessitating the development of sustainable remediation approaches. This study investigated the dye-degradation capability of a filamentous cyanobacterium, strain P1, isolated from a freshwater environment in Sri Lanka. The organism's performance was evaluated under oligotrophic conditions using 10 ppm reactive blue dye solution, without supplemental nutrients. Over a 28-day incubation period at room temperature with 2000-3000 lux illumination, the 75.19% decolorization efficiency was observed, as measured by UV-Vis spectrophotometry at the λmax (616 nm) of the dye. Remarkably, this degradation occurred alongside, throughout substantial cyanobacterial growth, achieving 94.91% of maximum growth potential (OD680) and yielding an average biomass production of 50 mg/day. Phytotoxicity assessment using *Vigna radiata* (green gram) demonstrated significant detoxification, statistically analysed by one-way ANOVA, with treated samples showing mean root and shoot lengths of 8.47 cm and 7.10 cm respectively, comparable to control treatments. These findings suggest that P1 may possess robust metabolic pathways capable of simultaneously degrading complex dye molecules and sustaining growth under nutrient-limited conditions. The organism's ability to utilize the dye as a potential nutrient source while achieving effective decolorization highlights its potential for practical bioremediation applications. Notably, the absence of nutrient requirements simplifies potential scale-up processes and reduces treatment costs. The results indicate that P1 could serve as an efficient, eco-friendly solution for textile dye wastewater treatment, particularly in resource-limited settings. Its performance may be further enhanced in real wastewater conditions containing additional organic and inorganic compounds that could serve as supplementary nutrients. Future research should focus on optimizing degradation kinetics, examining enzyme systems involved, and testing the strain's efficacy against higher dye concentrations and mixed dye effluents to fully assess its practical applicability in industrial wastewater treatment systems.

Keywords: *Decolorization, detoxification, eco-friendly, phycoremediation, reactive dye.*

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Isolation of starch-hydrolyzing thermophilic bacteria from the environment and screening for the thermostable α-amylase of *Bacillus licheniformis*

J.A. Ruhunage[1*], M. Kathirgamanathan[1], K.L.N.S. Perera[1], J.C. Kasturiarachchi[2]

[1]*Genetech, Colombo 08, Sri Lanka,*
[2]*Department of Applied Sciences, Faculty of Humanities & Sciences, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka*

**jayani.genetech@gmail.com*

Thermo-stable α-amylase is one of the most widely used enzymes in industries worldwide. Since it is not commercially produced in Sri Lanka, foreign exchange is spent to import it. The present study aimed to isolate thermophilic starch-hydrolyzing bacteria from the local environment of Sri Lanka and screen them for the thermo-stable α-amylase of *Bacillus licheniformis*. Soil samples from four different locations and a kitchen swab were inoculated in a minimal medium with starch as the sole source of carbon and with 5% (w/v) NaCl and were incubated at 50 °C. Twenty bacterial isolates were obtained from the enrichment and were screened for amylase activity by spot-inoculating on LB agar with starch and flooding the growth with iodine solution. Eleven isolates were found to be amylolytic and were characterized through Gram staining and colony morphology. Seven isolates, which were Gram positive bacilli, were screened for the presence of the *amyL* gene of *B. licheniformis* through specific PCR amplification. Three of them were found to have the *amyL* gene. The eleven amylolytic isolates were grown in a liquid medium for amylase production and the culture supernatants were treated at 80 °C for an hour to determine their thermo-stability. Two out of the three isolates which contained the *amyL* gene were found to have thermo-stable α-amylase activity. These results indicate that three of the twenty isolates were *Bacillus licheniformis*, but only two of them produced thermo-stable amylase. Thus, this study resulted in the successful isolation of *Bacillus licheniformis* with thermostable amylase activity from the local environment. The *amyL* gene from one of the two isolates could be cloned into a high expression vector for commercial production and application in various industries.

Keywords: *Amylolytic, de-sizing, enzyme*

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Multiplex qPCR-based gene dosage determination in non-invasive specimens: Technical challenges with long amplicons (>150bp)

W.A.D.M. Subawickrama[1], T.M.O.D. Tennakoon[1], N. Warsapperuma[2], D.M. Ranaweera[3], D.C. de Silva[4], N. Perera[5], G.H. Galhena[1*]

[1]*Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Colombo, Sri Lanka,*
[2]*North Colombo Teaching Hospital, Ragama, Sri Lanka*
[3]*Department of Chemistry, Faculty of Science, University of Colombo, Colombo, Sri Lanka,*
[4]*Department of Physiology, Faculty of Medicine, University of Kelaniya, Kelaniya, Sri Lanka,*
[5]*Genetech Molecular Diagnostics, Colombo, Sri Lanka*

**gayani@zoology.cmb.ac.lk*

Multiplex qPCR assay is widely used for copy number variation (CNV) detection via gene dosage (GD) analysis in conditions like the 22q11.2 deletion syndrome (DS). Non-invasive samples (NIS) are increasingly preferred over blood due to reduced discomfort. However, NIS often contains fragmented DNA, which compromises amplification efficiency, especially for longer amplicons. The study aimed to evaluate the impact of DNA source (NIS vs. blood) on GD determination using multiplex qPCR when targeting a relatively long DNA fragment (>150 bp). Seventeen NIS and seventeen blood samples from healthy volunteers were analysed using a duplex TaqMan qPCR assay as described by Tennakoon et al. (2024) for 22q11.2 deletion detection. GD (expected GD: $GD_{deleted}$=0.5; $GD_{non\text{-}deleted}$=1.0) was assessed using the $2^{-\Delta\Delta CT}$ method, with *SHANK3* (93bp) as reference gene and *PI4KA* (165bp) as the target. A confirmed healthy blood-derived control was used as the calibrator. Mean ΔCq ($\Delta Cq = PI4KA$ Cq $- SHANK3\ Cq$) values between the two groups were compared using Welch's t-test, testing the hypothesis that ΔCq value is significantly higher (less negative corresponding to a smaller Cq gap) in NIS, indicating poorer amplification of the longer *PI4KA* target. In blood samples, *PI4KA* consistently showed lower Cq values than *SHANK3*, suggesting higher amplification efficiency. In contrast, NIS exhibited a significantly increased ΔCq value (smaller Cq gap) (-0.35±0.69 vs. -1.54±1.25 in blood, $p<0.05$), and in some cases, *PI4KA* showed higher Cq than *SHANK3*. This resulted in deviated GD values for NIS (0.413±0.15) compared to blood (1.063±0.27). However, using a NIS-derived calibrator corrected the deviation (GD:1.062±0.25). This study indicates the importance of using shorter amplicons and specimen-matched calibrators for reliable qPCR-based GD analysis in NIS, improving accuracy in CNV detection.

Keywords: *$2^{-\Delta\Delta CT}$ method, amplification efficiency, copy number variation, DNA fragmentation, haploinsufficiency*

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Mitochondrial DNA integrity as a potential biomarker for early detection of breast cancer in a Sri Lankan cohort

R.M.I.S. Rathnasena[1,2], P.K.D.C. Yasara[2], N.R.P. Perera[3], I. Kumarasinghe[3], J. Balawardena[3], S. Viswakula[2], N. Perera[4], G.H. Galhena[2*]

[1]*Post Graduate Institute of Agriculture, University of Peradeniya, Sri Lanka*
[2]*Faculty of Science, University of Colombo, Sri Lanka*
[3]*University Hospital, General Sir Kotelawala Defence University, Sri Lanka*
[4]*Genetech Molecular Diagnostics, Sri Lanka*

[*]*gayani@zoology.cmb.ac.lk*

Circulating cell free DNA (ccf-DNA) is emerging as a rapid, cost effective, liquid biopsy tool. Mitochondrial DNA (mtDNA) release during apoptosis and necrosis forms a major component of ccf-DNA. Its fragmentation (ccf-mtDNA integrity) is closely linked to mitochondrial dysfunction and disrupted apoptosis-hallmarks of cancer. This study aims to assess mtDNA integrity index (mtDII) as a potential biomarker for early detection of breast cancer (BC) in a Sri Lankan cohort. A case control study was conducted with 55 females: 26 BC patients and 29 age matched controls. Two fragments of *MT-RNR2* gene (79bp and 230bp) were quantified using dye based quantitative PCR (qPCR), normalized against Glyceraldehyde 3-phosphate dehydrogenase (*GAPDH*) gene as described by Meng et al. (2019). Relative quantities of each fragment size were calculated as $2^{(\Delta Cq)}$. SPSS software was used to statistical analysis. According to results, no significant difference ($p > 0.05$) in mtDII was observed between BC and control group. The area under the curve (AUC) from receiver operating characteristic (ROC) was 0.581 with a sensitivity of 50% and a specificity of 55.2% at a cutoff value of 0.537. One-way ANOVA indicated that mtDII did not differ significantly ($p > 0.05$) across small (< 1.99cm), medium (2-4.99cm) and large (> 5cm) tumors. Independent t-tests revealed no significant differences ($p > 0.05$) in mtDII between moderately differentiated (T2; mtDII=0.503±0.122) and poorly differentiated (T3; mtDII=0.533±0.122) tumors. A significant negative correlation was observed between mtDII and age (Spearman's correlation analysis; $p < 0.05$). The results indicate that, mtDII lacks discriminatory power to effectively distinguishing BC patients from controls. The poor diagnostic performance may be influenced by confounding factors such as small sample size, age-related mitochondrial changes and underlying comorbidities in the control group. Future studies with larger, stratified cohorts are recommended to better evaluate mtDII's clinical utility in early BC detection.

Keywords: *Apoptosis, cell-free DNA, mitochondrial fragmentation, mtDNA integrity index, necrosis*

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Surface engineering of Foley catheters with curcumin-modified silver nanoparticles to inhibit *Proteus mirabilis* colonization

N.M.C. Nissanka[1], K.A.A. Dilhari[2*], G. Priyadarshana[3], J.A. Munasinghe[4], M. Dilshani[5], M.M. Weerasekera[1]

[1]*Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka*
[2]*Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Sri Lanka*
[3]*Department of Materials and Mechanical Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka*
[4]*Boffin Institute of Data Science, Makola, Sri Lanka*
[5] *Department of Mathematics, University of Ruhuna, Matara*

[*] *ayomidil@sjp.ac.lk*

The long-term use of indwelling urinary catheters often leads to complications such as biofilm formation and encrustation, particularly in infections involving *Proteus mirabilis*. This study aimed to develop and characterize a urinary catheter surface coated with curcumin-modified silver nanoparticles (curcumin-AgNPs) to inhibit *P.mirabilis* colonization and biofilm development. Catheters were pre-treated with 20% H_2SO_4 for 3 minutes, followed by luminal injection of curcumin-AgNPs solution, sonication, and drying at 50°C. The coating was assessed using Fourier-transform infrared spectroscopy(FTIR), Atomic Force Microscopy(AFM), scanning electron microscopy-energy dispersive X-ray (SEM-EDX) analysis, and contact angle assays. The antimicrobial efficacy was examined by direct contact assay, serial plate transfer test(SPTT), and time kill assay. FTIR confirmed successful surface modification through the appearance of curcumin-specific bands and shifts in the Si–O–Si backbone of silicone. SEM revealed uniform nanoparticle deposition with roughened topography and densely distributed spherical particles ranging from 30-164 nm in size. EDX confirmed silver presence (12.43wt%) and masking of the original silicone (Si reduced from 5.61 to 0.21wt%). AFM demonstrated increased nanoscale roughness (Ra from 9.22 to 82.38 nm), and contact angle analysis showed enhanced hydrophobicity (from 67.77° to 115.47°). Stability assays revealed moderate resistance to UV, heat, and acid, while significant reductions in hydrophobicity were observed under alkaline and freeze–thaw conditions. Release studies demonstrated sustained and differential release profiles, with 51.33% of silver and 76.05% of curcumin released over 14 days, both fitting the Korsmeyer–Peppas model. Antimicrobial assessments using direct contact assay and SPTT showed pronounced inhibition zones against *P.mirabilis* clinical strains. Time-kill assays demonstrated a significant reduction in viable bacteria over 72 hours on coated surfaces (final counts <1.5 $\log_{10}$CFU/mL), contrasting with persistent colonization on uncoated controls (>6.0 $\log_{10}$CFU/mL). Curcumin-AgNPs coating enhances the catheter's physicochemical and antimicrobial properties, offering a promising strategy to prevent *P. mirabilis* colonization in urinary catheters.

Keywords: *Antimicrobial, biofilm, coating, encrustation, nanoscale*

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Improving curcumin bioavailability using coaxial electrospun nanofibers with piperine: assessment of encapsulation efficiency and thermal stability

M.R.F. Sara[1], U.B.H.G.R.L. Bokalawela[1], B.M.S.K. Rodrigo[1]*

[1]*Department of Chemistry, Faculty of Natural Sciences, The Open University of Sri Lanka*

**srodr@ou.ac.lk*

Curcumin is a polyphenolic compound with promising pharmacological properties; however, its clinical efficacy is hindered due to its poor bioavailability and rapid metabolic degradation. This study presents a focused characterisation of coaxial electrospun nanofibers in polyvinyl alcohol (PVA) matrices, with curcumin in the core and piperine, a known metabolic inhibitor, in the sheath. Rather than a broad material study, this work centres on three critical aspects: Fourier-transform infrared (FTIR) spectroscopy, thermogravimetric analysis (TGA), and the quantification of encapsulation efficiency (EE) and loading capacity (LC). FTIR was employed to investigate the chemical interactions between the encapsulated compounds and the polymer matrix. The IR spectra of the fabricated nanofibers retained characteristic peaks of curcumin (3328 cm^{-1},1624 cm^{-1}, 1510 cm^{-1}) and piperine (1633 cm^{-1}, 1253 cm^{-1}), without the emergence of new peaks, confirming that the interactions are primarily physical, such as hydrogen bonding, and that no covalent modifications occurred. This preservation of structural integrity is crucial for maintaining the bioactivity of both compounds. TGA was used to evaluate the thermal stability of the nanofibers. The analysis revealed that encapsulation increased the degradation onset temperature of curcumin from around 178 °C to 215 °C, suggesting that the nanofiber structure significantly improved its thermal stability. Systematic analysis using UV–visible spectrophotometry revealed high encapsulation efficiencies of 78.5% for curcumin and 74.2% for piperine, with corresponding loading capacities of 13.2% and 12.6%, reflecting the effectiveness of the coaxial electrospinning method in encapsulating bioactive components. The findings demonstrate that careful material characterisation of curcumin–piperine nanofibers, can substantiate their potential for improving drug stability, enhancing bioavailability, and enabling controlled release. These insights offer valuable implications for future pharmaceutical formulations aimed at overcoming curcumin's bioavailability limitations through piperine-mediated metabolic inhibition.

Keywords: *Loading capacity, polyvinyl alcohol, thermogravimetric analysis*

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Determination of ethanol content in Sri Lankan marketed preparations of "*Nimba Arishta*" using Gas Chromatography – Flame Ionization Detection

D.T. Paranawithana[1*], M.A.J. Wansapala[1]

[1]*University of Sri Jayewardenepura, Sri Lanka*

[*]*pwdishanithakshila@gmail.com*

Ayurvedic medicinal products containing natural ingredients are widely perceived by the public as safer and more effective alternatives to synthetic chemical-based formulations due to their lower risk of adverse side effects. Among these, *Arishta* are widely utilized fermented Ayurvedic formulations available in the Sri Lankan market. The ethanol content of these formulations must be carefully monitored because it greatly affects the absorption and effectiveness of these products. It is important to ensure that consumers receive authentic and high-quality formulations to maintain trust in Ayurvedic medicine. The objective of the present study was to assess the ethanol content of some samples of '*Nimba arishta*' available in a range of brands in the Sri Lankan market. In this study, samples from six different local manufacturers as over-the-counter products were obtained. Their ethanol contents were determined using a gas chromatograph with a flame ionization detector (GC-FID). 1%(v/v) acetonitrile was used as the internal standard and the sample solutions were directly injected. Statistical analyses were performed using one-way ANOVA with 95% confidence level (α=0.05) followed by Tukey's test. According to results, a maximum ethanol content of 10.4 ± 0.141% v/v and a minimum of 7.65 ± 0.07% v/v were detected across the samples. Statistically significant differences were observed in the ethanol content of the same *Arishta* formulation from different brands highlighting inconsistencies in the manufacturing or formulation practices. The lack of established guidelines for monitoring ethanol content not only raises concerns about therapeutic effectiveness but also potential risks associated with long-term use. These findings underscore the urgent need for standardized methods and regulatory mechanisms to ensure the quality, safety, and efficacy of Ayurvedic products in Sri Lanka.

Keywords: *Ayurveda, fermented preparations, GC-FID, polyherbal formulations, standardization*

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Unveiling the diversity of dung-inhabiting mushrooms in Sri Lanka: A morphological and molecular perspective

H.N.M. Perera[1,2], T.T.M. Peiris[1,2], I.S.S.C. Uyangoda[1], W.G.B.P. Dharmasena[1,3], K.M. Thambugala[1,4*]

[1]*Centre for Plant Materials and Herbal Products Research, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Applied Sciences, Faculty of Humanities and Sciences, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka*
[3]*Department of Biosystems Technology, Faculty of Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[4]*Genetics and Molecular Biology Unit, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

[*]*kasun@sci.sjp.ac.lk*

Despite the global abundance of fungi, many species remain unexplored and require accurate identification. Coprophilous fungi, some of which form mushrooms on herbivore dung, play a vital role in maintaining ecological balance by decomposing animal waste and providing a food source for coprophagous and mycophagous arthropods. Additionally, some coprophilous fungi possess a medicinal value, exhibiting antimicrobial, antidiabetic and anticancer properties. Although coprophilous fungi have been studied in many parts of the world, similar research is scarce in Sri Lanka, and the diversity and taxonomy of these ecologically important fungi remain poorly understood. Addressing this knowledge gap, the present study aimed to characterize selected coprophilous mushrooms in Sri Lanka using both morphological and molecular approaches. Several mushroom samples were collected from Colombo, Ratnapura, and Gampaha districts, associated with elephant dung. Dried fruiting bodies were used for DNA extraction with liquid nitrogen, following the 4X Cetyltrimethylammonium Bromide (CTAB) method. PCR amplification was performed amplifying the Internal Transcribed Spacer (ITS) gene region using ITS1 and ITS4 primer pairs. Macro and Micromorphological characteristics such as size, colour, shape of mushroom pileus (cap), stipe (stalk), gills (lamellae), and basidiospores were used for the morphological analysis, while ITS rDNA sequence data was employed for the phylogenetic analyses. Based on morphological observations and ITS rDNA-based phylogenetic analyses, four coprophilous mushroom species, *Conocybe volvata*, *Coprinus cordisporus*, *Panaeolus antillarum* and *P. cyanescens* were identified from elephant dung are described here for the first time in Sri Lanka.

Keywords: *Coprophilous, DNA barcoding, ITS rDNA, morphology, phylogeny.*

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An investigation of the antibacterial potential of selected local medicinal plants belonging to the Fabaceae, Lamiaceae and Asteraceae families

K.M.T.N. Dalsika[1], Hiruni C. Rathnapala[2], H.G.S.D. Gamage[1], H.P.S. Jayaweera[3], J. Perera[4], S. Jeevathayaparan[1], N.S. Muthunayake[1*]

[1]*Department of Biochemistry, Faculty of Medicine, Wayamba University of Sri Lanka*
[2]*Department of Physiology, Faculty of Medicine, Wayamba University of Sri Lanka*
[3]*Department of Microbiology, Faculty of Medicine, Wayamba University of Sri Lanka*
[4]*Department of Medical Microbiology and Immunology, Faculty of Medicine, University of Colombo*

**nisansalas@wyb.ac.lk*

The identification of novel plant-based antibacterial drugs is a promising strategy to overcome the problem of antibiotic resistance. Although Sri Lanka harbours a variety of medicinal plant species, the antibacterial potential of many of these remains unexplored. The goal of our research is to screen selected medicinal plants for antibacterial activity and to utilize in the development of novel therapeutic. Plants belonging to the Fabaceae family *Mimosa pudica*, the Lamiaceae family *Ocium tenuiflorum* and the Asteraceae family *Vernonia cinera* were selected for the study. Our aim was to investigate the phytochemical profiles, individual and synergistic antibacterial activities of the leaf extracts against the Gram-positive Bacterium *Staphylococcus aureus* and the Gram-negative bacterium *Escherichia coli*. Phytochemical screening (Mayer's test for alkaloids, Ammonia test for flavonoids, Salkowski test for terpenoids, $CuSO_4$ test for resins and I_2/KI test for phenolic compounds) was done for each leaf extract. The results revealed that *Mimosa pudica* and *Ocimum tenuiflorum* contained all the tested phytochemicals whereas *Vernonia cinerea* lacked flavonoids but contained the other compounds. Antibacterial activity was monitored using agar well diffusion method. Only individual methanol extracts of *M. pudica* and *V. cinerea* (zones:11.67 ± 0.88 mm each) inhibited *S. aureus*. In synergistic studies, combinations [*M. pudica* + *V. cinerea*, *O. tenuiflorum* + *M. pudica*, *V. cinerea* + *O. tenuiflorum*, all three; zones: (11.67 ± 0.34, 12.0 ± 0.6, 9.34 ± 0.34, 10.0 ± 0) mm] inhibited *S. aureus*. Neither the individual methanol extracts nor combinations affected *E. coli*. This might be due to the presence of **a** rigid cell wall structure in *E. coli* compared to *S. aureus*. Interestingly, preliminary results showed that the selected plants exhibit a potent phytochemical profile and promising antibacterial potential. This study would serve as a foundation to evaluate the synergistic combinations of plant extracts of above families and their efficiency against bacterial infections.

Keywords: *Antimicrobial, phytochemical, therapeutics, well diffusion*

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Genetic diversity in Sri Lankan hatchery broodstocks of giant freshwater prawn (*Macrobrachium rosenbergii*): Implications for genetic management and sustainable aquaculture

H.D.H.P. Piyarathna[1], L.G.S. Lokugalappatti[2], S.T. Gonapinuwala[1], S.A.S. Pilagolla[1], N. de Silva[3], M.D.S.T. de Croos[1*]

[1]*Department of Aquaculture & Fisheries, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, 60170, Sri Lanka*
[2]*Department of Basic Veterinary Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Nanotechnology, Faculty of Technology, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka*

[*]*dileepad@wyb.ac.lk*

The sustainability and long-term viability of culture-based fisheries are intrinsically linked to the genetic integrity of hatchery broodstock, particularly in economically vital species such as giant freshwater prawn. In Sri Lanka, the National Aquaculture Development Authority (NAQDA) has implemented nationwide breeding and stocking programs to enhance inland prawn production. However, these initiatives lacked systematic genetic monitoring, raising concerns about potential genetic erosion. Notably, recent observations of distinct phenotypic variations, including divergent morphologies among hatchery stocks highlight the need for molecular-level assessments. This study presents the first genetic investigation of *M. rosenbergii* hatchery broodstock in Sri Lanka using mitochondrial DNA cytochrome oxidase I (mtDNA COI) as a molecular marker. Sixteen broodstock individuals were sampled from four major hatcheries: Pambala (North-western), Kahandamodara (Southern), Kallarawa (Eastern), and a private hatchery in Negombo, of which nine samples were successfully sequenced and analyzed bioinformatically. The results revealed extremely limited genetic variability, with only two haplotypes and single polymorphic site identified at the Pambala station. Calculated haplotype diversity (Hd = 0.2222) and nucleotide diversity ($\pi = 0.00039$) were remarkably low. Phylogenetic and haplotype analyses robustly confirmed genetic homogeneity with clustering the samples of Sri Lankan hatcheries into a single clade alongside reference sequences from Bangladesh and China. These findings emphasize a narrow genetic base within the hatchery broodstock, indicating risks of inbreeding and increased vulnerability to environmental and disease-related stressors. The observed phenotypic divergence is likely driven by environmental influences rather than genetic differentiation. The study underscores the urgent need to integrate genetic management into existing hatchery operations, recommending periodic introduction of wild germplasm, implementation of broodstock rotation schemes, and routine molecular screening protocols. Such measures are essential to enhance genetic diversity, mitigate inbreeding depression, ensuring long-term resilience, productivity and sustainability of Sri Lanka's freshwater prawn aquaculture industry.

Keywords: *Haplotype diversity, inbreeding, Macrobrachium rosenbergii, mitochondrial DNA (mtDNA COI)*

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Microbial diversity and biofilm-forming ability of uropathogens co-existing with *Proteus mirabilis* in mixed-species catheter biofilms of catheter-associated urinary tract infection patients

H.M.H.L. Herath[1*], M.J.F. Fasha[1], P.R.D.C. Perera[1], N.M.C. Nissanka[2], K.A.A. Dilhari[3]

[1]*Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[3]*Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

[*]*mailto:herathhashani27@gmail.com*

Catheter-associated urinary tract infections (CAUTIs) are among the most common hospital-acquired infections, with urease-producing *Proteus mirabilis* recognized as a major causative agent due to its ureolytic activity that facilitates crystalline biofilm formation. *P. mirabilis* frequently occurs in polymicrobial biofilms, particularly in long-term catheterized patients, where its interactions with other uropathogens enhance encrustation and infection persistence. This study uniquely explores the microbial diversity and biofilm-forming ability of uropathogens co-existing with *P. mirabilis* in mixed-species biofilms on indwelling urinary catheters. This descriptive cross-sectional study was conducted by recruiting 76 CAUTI patients at the Colombo South Teaching Hospital, Kalubowila, following CDC (2024) diagnostic criteria, to identify uropathogens co-existing with *P. mirabilis* in mixed-species biofilms and to assess their biofilm-forming capacity. Uropathogens which responsible for CAUTI were identified using HiCrome™ UTI agar, and selected plates were validated with ATCC reference strains to confirm characteristic color reactions. Biofilm quantification on patients' catheter segments was carried out using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) and crystal violet (CV) assays, with mean values representing overall biofilm density. *P. mirabilis* was detected in 36 (36/76;47.37%) catheter samples, forming mixed-species biofilms with six co-pathogens, of which *Enterococcus faecalis* (72.22%), *Escherichia coli* (58.33%), and *Klebsiella* spp. (44.44%) were the most common. *Candida* spp. were absent, indicating a predominantly bacterial community. The biofilm strength dominated by *P. mirabilis* may be influenced not only by the presence of different co-pathogens but also by demographic factors (age, gender) and clinical factors (duration of catheterization, comorbidities). Since biofilm formation depends on several interacting factors, variations in biofilm strength were considered descriptive rather than statistically evaluated. These findings highlight the polymicrobial complexity of CAUTIs and the synergistic role of *P. mirabilis* in biofilm-associated pathogenesis, emphasizing the need to address mixed-species interactions in prevention and management strategies.

Keywords: *Catheter-associated urinary tract infections, Proteus mirabilis, polymicrobial biofilms, encrustation, hospital acquired infections*

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In vitro evaluation of the anticholesterol potential and cytotoxicity of a combination of herbs for prospective nutraceutical applications

D.M. Silva[1], S. Alahakoon[2], A.I. Kuruppu[1*]

[1]*Institute for Combinatorial Advanced Research and Education, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*
[2]*Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka*

**Kuruppua@kdu.ac.lk*

Nutraceuticals derived from plants are being investigated as treatments for hypercholesterolemia because of their high phytochemical content and low adverse reactions. The cytotoxic safety and anticholesterol activities of two powdered herbs, *Garcinia quaesita* and *Moringa oleifera*, will be evaluated in this study. Both herbs are traditionally used for their lipid-lowering properties. The individual effects of each plant were investigated in a previous study, and it was found that combining them may enhance the overall efficacy. Therefore, *G. quaesita* fruits and *M. oleifera* leaves were ground and mixed in various weight ratios for further assessment. The Liebermann-Burchard assay was used to measure the cholesterol-lowering capacity at a concentration of 1 mg/mL for all selected ratios. For cytotoxicity testing, two combinations were chosen: G20:M80, and G30:M70. The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay was used to assess cytotoxic effects on the chosen ratios against Vero, BHK, and HepG2 cell lines. Cholesterol reduction results showed that the G20:M80 ratio had the highest inhibition at 45.15% ± 0.09, followed by G30:M70 (42.19% ± 0.14). Atorvastatin, the reference drug, demonstrated 61.03% ± 0.96 inhibition at 1 mg/mL ($p<0.05$). In the MTT cytotoxicity assay, Vero cells displayed inhibition of 63.28% ± 0.04 for G20:M80 and 68% ± 2.26 for G30:M70, underscoring selective cytotoxicity with moderate impact ($p<0.05$). Similarly, BHK cells showed inhibition of 62.77% ± 12.64 (G20:M80) and 65.43% ± 4.59 (G30:M70), reflecting selective cytotoxicity and moderate safety profiles($p>0.05$). HepG2 cells exhibited high cytotoxicity across the tested ratios, ranging from 79.72% ± 2.00 (G20:M80) to 86.18% ± 0.47 (G30:M70), supporting the potential anticancer properties of the formulation ($p<0.05$). The combination of *Moringa oleifera* and *Garcinia quaesita* exhibited strong anticholesterol activity, along with selective cytotoxicity against cancer cells and only moderate toxicity in normal cell lines. These findings highlight the potential of these formulations as effective nutraceutical candidates for the management of hypercholesterolemia, demonstrating a reasonable safety margin in non-cancerous cells. However, further studies are warranted to confirm these effects.

Keywords: *Anticholesterol activity, cytotoxicity, garcinia, moringa, MTT assay*

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Investigation of *In Vitro* anti-inflammatory activity and cytotoxic activity of *Padina Species*

A.G.N. Nirmali[1], K.W. Samarakoon[1], A.I. Kuruppu[1*]

[1]*Institute for Combinatorial Advanced Research and Education, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*

[*]*kuruppua@kdu.ac.lk*

Marine algae, especially brown algae of the genus *Padina*, have gained increased attention due to their broad spectrum of pharmacological activities, particularly their anti-inflammatory and anticancer properties. These algae are a rich source of structurally diverse and biologically active compounds, including polyphenols, sulphated polysaccharides, flavonoids, and terpenoids. Natural products from marine algae have shown significant therapeutic potential and are promising candidates in the process of lead discovery for the development of new drugs. Daily intake of marine algae in the diet has also been related to health advantages such as reduced occurrence of inflammatory conditions, cancer (particularly breast cancer), and hyperlipidaemia. In the current study, *Padina* hydro methanolic extract was evaluated for in vitro anti-inflammatory and cytotoxic properties. Anti-inflammatory activity was assessed by two conventional assays, namely protein denaturation and human red blood cell (HRBC) membrane stabilization. The extract exhibited considerable inhibition of protein denaturation of up to 33.47 ± 0.00% and exhibited potent membrane-stabilizing activity with 93.20 ± 1.54% inhibition in the HRBC assay at 1 mg/mL. The IC_{50} value in the HRBC assay was 0.028 ± 0.004 mg/mL, indicating strong anti-inflammatory potential at low concentrations. The anticancer activity was determined by conducting MTT assays on two cancer cells, MCF-7 (breast) and HepG2 (liver). The *Padina* extract demonstrated dose-dependent cytotoxicity with the greatest inhibition values of 67.95 ± 0.09% and 67.88 ± 1.55% against MCF-7 and HepG2 at 1 mg/mL, respectively. The IC_{50} values were 0.062 ± 0.02 mg/mL against MCF-7 and 0.057 ± 0.02 mg/mL against HepG2, demonstrating significant cytotoxic effects at low concentrations. In conclusion, the findings of this research reveal that *Padina* species possess potent anti-inflammatory and anticancer properties, supporting their potential for drug development through the isolation of active compounds and identification of their underlying mechanism of action.

Keywords: *MCF-7, HepG2, Human red blood cell membrane stabilization, Natural products, Padina spp.*

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Antioxidant, anti-dyslipidemic, and cytotoxic properties of medicinal plants: *Ipomoea cordatotriloba* Denn., *Eclipta prostrata* (L.) L., *Portulaca oleracea* L., and *Peperomia pellucida* (L.) Kunth

M.N.F. Yusra[1,2], Y.G.A.D.K. Bandara[1], K.G. Nelum. P Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1], M.T. Napagoda[3]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[3]*University of Ruhuna, Galle, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Medicinal plants are valuable sources of bioactive compounds with potential therapeutic effects against oxidative stress and dyslipidemia. This study investigated the in vitro antioxidant, anti-dyslipidemic, and cytotoxic activities of aqueous extracts from four medicinal plants: *Eclipta prostrata* (L.) L. (False Daisy), *Portulaca oleracea* L. (Purslane), *Peperomia pellucida* (L.) Kunth (Pepper Elder), and *Ipomoea cordatotriloba* Denn. (Tievine), the latter being relatively less studied. Antioxidant activity was assessed using the Ferric Reducing Antioxidant Power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assays. Anti-dyslipidemic potential was evaluated through a lipase inhibition assay, while cytotoxicity was determined using the brine shrimp lethality bioassay. Among the tested extracts, *I. cordatotriloba* exhibited the highest reducing power in the FRAP assay, whereas *E. prostrata* demonstrated the strongest DPPH radical scavenging activity (IC_{50} = 147.13 ± 1.20 mg L^{-1}). Both *E. prostrata* and *P. pellucida* displayed strong overall antioxidant activities, consistent across both DPPH and FRAP results. None of the extracts showed significant lipase inhibition at 1000 mg L^{-1}. Cytotoxicity screening revealed moderate toxicity in *P. pellucida* (LC_{50} = 249.90 ± 0.20 mg L^{-1}) and concentration-dependent lethality in *I. cordatotriloba*. *E. prostrata* and *P. oleracea* exhibited mild toxicity (13.33 ± 5.77%). These results suggest that *E. prostrata* and *P. pellucida* possess notable antioxidant potential, while *P. pellucida* and *I. cordatotriloba* display cytotoxicity at higher concentrations. Statistical analyses were performed using one-way ANOVA followed by Tukey's post hoc test, with significance set at $p < 0.05$. Further studies are recommended to isolate and characterize the active constituents responsible for these bioactivities using bioassay-guided fractionation and advanced spectroscopic techniques.

Keywords: *Bioactive compounds, ferric reducing ability, lipase inhibition, medicinal plant extracts, radical scavenging assay*

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A preliminary study on selected biological activities of *Psychotria sarmentosa*

P.D.J.S.N. Wijerathna[1], Y.G.A.D.K. Bandara[1], N.K.B. Adikaram, L. Jayasinghe[1], K.G. Nelum P. Piyasena[1*]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Psychotria sarmentosa, locally known as "Gonika," is a climbing plant in the Rubiaceae family. It is used in Sri Lankan folk medicine, particularly for treating bone fractures and inflammatory conditions. Despite its traditional use as a folk medicine, scientific validation of its biological properties remains limited. This study aimed to conduct a preliminary investigation on selected bioactivities of *P. sarmentosa* leaves, including: antioxidant activity, phytotoxicity, and cytotoxicity. Fresh leaves were collected, dried, and extracted with methanol via ultrasonication. Then the resulting crude extract was subjected to standard bioassays. Antioxidant activity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and Ferric Reducing Antioxidant Power (FRAP) assay. The extract exhibited DPPH radical scavenging activity with an IC_{50} of 18.16 ± 6.45 mg/L, however, the positive control (ascorbic acid), showed stronger activity (IC_{50} value of 7.90 ± 0.10 mg/L) compared to the *P. sarmentosa* extract. In the FRAP assay, the extract showed strong ferric reducing power (1434.94 ± 31.88 µmol $FeSO_4$/g), showcasing a good electron-donating ability. Phytotoxicity was evaluated using the lettuce seed (*Lactuca sativa*) germination assay with a 1000 ppm crude extract. The results showed 25.92 ± 3.51% inhibition of root growth and 16.03 ± 11.48% stimulation of shoot growth. Cytotoxicity was tested using the brine shrimp lethality assay, where the extract demonstrated a relatively high LC_{50} value of 3542.39 ± 1015.77 mg/L, compared to the positive control $K_2Cr_2O_7$, (LC_{50} of 7.97 ± 0.97 mg/L), indicating that *P. sarmentosa* is a plant with very low cytotoxicity. Overall, this research supports the traditional medicinal relevance of *P. sarmentosa* by demonstrating its strong radical scavenging activity, strong ferric reducing power, weak phytotoxicity, and non-cytotoxicity. Further investigations, including *in vivo* studies and isolation of bioactive compounds, are required to confirm its potential and safety for pharmaceutical, agricultural, cosmetic, or other commercial applications.

Keywords: *Antioxidant activity, cytotoxicity, Gonika, methanolic extract, phytotoxicity*

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Comparative study on bioactivity evaluation of methanolic leaf extracts of *Thespesia populnea and Ricinus communis*

K.G.R.A.C. Wijewardana[1], Y.G.A.D.K. Bandara[1], D.S. Jayaweera[1], K.G. Nelum.P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Sri Lanka is endowed with a rich diversity of medicinal plants, many of which serve as valuable sources of bioactive compounds for modern therapeutic applications. The present study aimed to investigate the bioactive potential of methanolic leaf extracts from *Thespesia populnea* (Gansuriya) and *Ricinus communis* (Endaru). Fresh leaves were collected from Kandy, Sri Lanka, and processed by washing, shade-drying, and powdering. The powdered material was extracted with methanol using an ultra-sonication method, repeated three times. The combined filtrates were concentrated using a rotary evaporator to obtain the crude extracts. These extracts were subjected to a series of bioassays to evaluate their antioxidant, cytotoxic, phytotoxic, and α-glucosidase inhibitory activities. Antioxidant capacity was assessed via the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and the Ferric Reducing Antioxidant Power (FRAP) assay. *T. populnea* demonstrated stronger antioxidant activity with a lower DPPH IC_{50} value of 57.92 ± 2.63 mg L^{-1}, compared to *R. communis*, which had an IC_{50} of 163.20 ± 9.05 mg L^{-1}. However, both extracts were less potent than the positive control, ascorbic acid (IC_{50} = 7.90 ± 0.10 mg L^{-1}). In the FRAP assay, *T. populnea* exhibited a high reducing capacity (1438.22 ± 31.39 µmol $FeSO_4$ g^{-1}), while *R. communis* showed a lower value (289.00 ± 7.40 µmol $FeSO_4$ g^{-1}). The standard, Trolox, recorded the highest FRAP value (1692.19 ± 0.10 µmol $FeSO_4$ g^{-1}). In terms of α-glucosidase inhibition at 1000 mg L^{-1}, *R. communis* demonstrated notable activity, with 62.20 ± 0.91% inhibition compared to the positive control, acarbose (76.48 ± 0.74%). In the brine shrimp lethality assay,only *T. populnea* exhibited moderate cytotoxicity, with an LC_{50} value of 158.72 ± 14.65 mg L^{-1}, whereas the standard, potassium dichromate ($K_2Cr_2O_7$), showed a much lower LC_{50} of 7.97 ± 0.97 mg L^{-1}. Both extracts displayed weak phytotoxic activity at 1000 mg L^{-1} in the lettuce seed (*Lactuca sativa*) germination assay. The overall findings of this study highlight the leaves of *T. populnea* had high antioxidant potential and cytotoxicity compared to *R. communis.* Future directions should be focused on isolating and characterizing bioactive compounds from these extracts.

Keywords: *Antioxidant activity, cytotoxicity, enzyme inhibition, phytotoxicity*

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Comparative bioactivity of *Sargassum sp.*, *Hypnea sp.*, and *Chaetomorpha sp.* collected from Kalpitiya and Udappuwa during the northeast monsoon

W.M.Y.B. Wanninayake[1,2], S.A.D. Chathurangi[1], N.K.B. Adikaram[1], L. Jayasinghe[1], K.G.N. Piyasena[1*]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura*

[*]*nelum.pi@nifs.ac.lk*

This study examined the bioactivity of methanolic extracts from three species of marine macroalgae: *Sargassum sp*. (collected from Kalpitiya), *Hypnea s*p., and *Chaetomorpha sp*. (both collected from the Chilaw-Udappuwa) during the northeast monsoon season. In this study, the antioxidant capacity was evaluated using DPPH radical scavenging and FRAP assays. Additionally, cytotoxicity, phytotoxicity, and alpha-amylase inhibitory activities were assessed. In the DPPH assay, *Sargassum sp*. showed the strongest radical scavenging activity (IC_{50} = 1593.50±5.23 mg/L), followed by *Hypnea sp*. (IC_{50} = 2924.70±1.62 mg/L) and *Chaetomorpha sp*. (IC_{50} = 3662.40±6.50 mg/L). However, all were significantly ($p<0.05$) less effective than the ascorbic acid control (IC_{50} = 7.90±0.10 mg/L). FRAP values of species are *Sargassum sp* 0.07±5.86 µmol Fe2+g$^-$, *Hypnea sp.* 0.07±4.32 µmol Fe2+g-, and *Chaetomorpha sp*. 0.07±5.02 µmol Fe2+g-. This result showed similar antioxidant capacities among the three species. Cytotoxicity screening displayed that *Hypnea sp*. had the lowest LC_{50} (1869.70±18.65 mg/L), indicating higher toxicity compared to *Sargassum sp*. (3414.60±12.56 mg/L) and *Chaetomorpha sp.* (19661.70±24.236 mg/L). Phytotoxicity tests showed varied effects on shoot and root growth. *Sargassum sp*. and *Hypnea sp*. showed both inhibitory and stimulatory effects depending on the concentration. In the alpha-amylase inhibition test, *Hypnea sp*. had the highest inhibitory activity (IC_{50} = 186.20±4.45 mg/L), followed by *Sargassum sp*. (IC_{50} = 625.50±5.96 mg/L). The positive control, acarbose, was significantly ($p<0.05$) more effective (IC_{50} = 45.99±0.07 mg/L). Bioactivity studies on these seaweed species from Chilaw and Kalpitiya coasts of Sri Lanka have not been conducted previously. This study provides a preliminary foundation for more comprehensive future investigations into impact of geographic location, environmental conditions, and harvesting time on the bioactive compound profile of marine microalgae.

Keywords*: Alpha-amylase inhibition, antioxidant activity, cytotoxicity, marine macroalgae.*

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Valorization of peel waste from *Passiflora edulis* sims red and yellow varieties through bioactivity assessment

K.W.R.R. Fonseka[1], S.A.D. Chathurangi[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Fruit peels are often discarded during fruit processing and treated as agricultural waste. Using fruit peels helps reduce waste and promotes circular economy practices by creating value-added products. This study investigated the bioactivity of methanolic extracts from the ripe peels of *Passiflora edulis* Sims, red and yellow varieties, cultivated in Sri Lanka. The crude extracts were evaluated for antioxidant activity using the *2,2-diphenyl-1-picrylhydrazyl* (DPPH) radical scavenging assay and ferric reducing power (FRAP) assay, as well as for their α-amylase inhibitory activity, cytotoxicity, and phytotoxicity properties. In the DPPH assay, red passion fruit peel showed higher radical scavenging activity (IC_{50}=394.70 ± 11.20 mg L^{-1}) than yellow passion fruit peel (IC_{50}= 643.35 ± 3.45 mg L^{-1}). However, both values were significantly lower than the positive control, ascorbic acid (IC_{50}= 7.90 ± 0.10 mg L^{-1}). Red passion fruit peel demonstrated a reducing power of 0.44 ± 0.01 mmol Fe^{2+} g^{-1}, higher than yellow passion fruit peel (0.40 ± 0.03 mmol $Fe^{2+}g^{-1}$) as measured by the FRAP assay. Still, Trolox showed a value of 1.26 ± 0.01 mmol Fe^{2+} g^{-1} as the positive control. Additionally, the peel extract of yellow passion fruit demonstrated α-amylase inhibitory activity, with a percentage inhibition of 12.95 ± 3.35% at a concentration of 1000 mg L^{-1}, in comparison to the standard inhibitor acarbose, which exhibited 59.82 ± 4.10% inhibition. In the brine shrimp lethality assay, only the red passion fruit peel showed an LC_{50} value of 136.72 ± 7.25 mg L^{-1} against $K_2Cr_2O_7$ as the positive control (7.90 ± 0.10 mg L^{-1}). The root inhibition at 1000 mg L^{-1} was 31.43 ± 0.00% for red peel and 33.33 ± 0.00% for yellow peel, while shoot growth was promoted in both cases. These findings suggest that both passion fruit peels display moderate bioactivity, and further research could explore potential applications in nutraceutical, pharmaceutical, and agricultural industries.

Keywords: *Antioxidant, Enzyme inhibition, Passiflora edulis, Peel*

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Assessment of the biological activities of methanolic extract of *Flueggea leucopyrus* Willd. and *Eryngium foetidum* L.

W.M.K.A.K. Rathnayake[1], S.A.D. Chathurangi[1], D.S. Jayaweera[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

**nelum.pi@nifs.ac.lk*

Sri Lanka is renowned for its rich diversity of medicinal plants, many of which possess significant potential for the development of novel therapeutics. The present study evaluated the biological activities of leaf extracts from *Flueggea leucopyrus* (Katupila) Willd. and *Eryngium foetidum* L. (Andu). Methanolic extracts of the leaves were subjected to a series of bioassays, including the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay, the ferric reducing antioxidant power (FRAP) assay, the brine shrimp lethality assay, and the lettuce seed germination assay for phytotoxicity. Plant materials were collected from the Matale District, Sri Lanka, and healthy, mature leaves were authenticated prior to extraction. Following shade drying and pulverization, the leaves were extracted with methanol to obtain crude extracts. In the DPPH assay, *F. leucopyrus* exhibited strong antioxidant activity, with an IC_{50} value of 22.75 ± 0.12 mg L^{-1}, while *E. foetidum* showed moderate activity with an IC_{50} of 94.47 ± 1.03 mg L^{-1}. Both were less potent than the reference compound, ascorbic acid (IC_{50} = 7.90 ± 0.10 mg L^{-1}). The FRAP assay further confirmed the antioxidant capacities of *F. leucopyrus* and *E. foetidum,* displaying FRAP values of 899.37 ± 11.11 µmol Fe^{2+} g^{-1} and 328.23 ± 11.52 µmol Fe^{2+} g^{-1}, respectively, compared to the positive control Trolox (1260 ± 10.00 µmol Fe^{2+} g^{-1}). In the brine shrimp lethality assay, *F. leucopyrus* and *E. foetidum* demonstrated moderate cytotoxic activity, with LC_{50} values of 605.22 ± 1.47 µg mL^{-1} and 415.19 ± 10.74 µg mL^{-1}, respectively. These were markedly less toxic than the positive control, potassium dichromate (LC_{50},7.97 ± 0.97 µg mL^{-1}). Neither extract exhibited significant phytotoxicity at 1000 µg mL^{-1} in the lettuce seed germination assay. Overall, the results suggest that both *Flueggea leucopyrus* and *Eryngium foetidum* possessed promising antioxidant and moderate cytotoxic properties, indicating their potential for future pharmaceutical and pharmacological applications.

Keywords: *Cytotoxicity, DPPH, FRAP, phytotoxicity*

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Antioxidant, cytotoxic and phytotoxic activities of methanolic leaf extract of *Bombax ceiba* L. and *Anisomeles indica* L.

S.A.R.N. Subhasinghe[1], S.A.D. Chathurangi[1], D.S. Jayaweera[1], K.G. Nelum P. Piyasena [1*], N.K.B. Adikaram[1], L. Jayasinghe [1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Bombax ceiba L. (Katuimbula) and *Anisomeles indica* L. (Yakwanassa), two medicinal plants traditionally used in Sri Lanka, were evaluated for their in vitro biological activities. Methanolic extracts were prepared from healthy, air-dried leaves and assessed for antioxidant, cytotoxic, and phytotoxic properties. Antioxidant activity was determined using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and the Ferric Reducing Antioxidant Power (FRAP) assay. Cytotoxicity was evaluated via the brine shrimp (Artemia salina) lethality assay, while phytotoxicity was assessed using the lettuce (Lactusa sativa) seed germination assay. *Anisomeles indica* exhibited high antioxidant potential with an IC_{50} value of 37.71 ± 2.18 mg L^{-1} in the DPPH assay, compared to *B. ceiba*, which showed an IC_{50} of 162.13 ± 5.54 mg L^{-1}. Both extracts were less potent than the positive control, ascorbic acid ($IC_{50} = 7.90 \pm 0.10$ mg L^{-1}). In the FRAP assay, *A. indica* displayed a higher reducing capacity (683.06 ± 1.25 µmol Fe^{2+} g^{-1}) than *B. ceiba* (353.06 ± 8.16 µmol Fe^{2+} g^{-1}), although both values were lower than the reference compound Trolox (1260 ± 0.01 µmol Fe^{2+} g^{-1}). In the brine shrimp lethality assay at 1000 mg L^{-1}, *B. ceiba* exhibited 70.14 ± 7.64% mortality, indicating moderate cytotoxicity, while *A. indica* showed 35.42 ± 2.08% mortality. These values were significantly lower than the cytotoxic effect of the positive control potassium dichromate ($LC_{50} = 7.97 \pm 0.97$ mg L^{-1}). Phytotoxicity results indicated minimal to no inhibitory effects on lettuce seed germination. *B. ceiba* demonstrated root and shoot growth stimulation, with inhibition values of -12.50 ± 1.54% and -25.92 ± 2.34%, respectively. *A. indica* showed a moderate root inhibition of 27.09 ± 16.70% and a slight stimulatory effect on shoot growth (-10.79 ± 18.83%). In conclusion, *Anisomeles indica* exhibited notable antioxidant activity and mild cytotoxicity, suggesting potential as a natural antioxidant source. Further phytochemical studies and in vivo evaluations are warranted to isolate active constituents and assess their therapeutic potential.

Keywords**:** *Brine shrimp lethality, dpph, frap, seed germination.*

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Evaluation of antioxidant and bioactivity potential of *Saraca indica* and *Erythrina subumbrans* flowers

K.R.D.A.K. Kahandawa[1], S.A.D. Chathurangi[1], D.S. Jayaweera[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

The exploration of the bioactivity potential of medicinal plants is essential for understanding their therapeutic properties; however, the research studies on the flowers of *Saraca indica* (Asoka) and *Erythrina subumbrans* (December Tree) remain limited. This study addresses the gap by focusing on the bioactivity of the flowers collected from Central Province, Sri Lanka. The samples were shade-dried, ground into a fine powder, and extracted with methanol using an ultra-sonication technique. The resulting extracts were concentrated using a rotary evaporator followed by drying in a vacuum oven. The crude methanolic extracts were subsequently evaluated for their antioxidant potential using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and the Ferric Reducing Antioxidant Power (FRAP) assay. Additionally, the extracts were assessed for cytotoxic activity via the brine shrimp (*Artemia salina)* lethality assay, phytotoxic activity through the lettuce (*Lactuca sativa*) seed germination assay, and α-glucosidase inhibitory activity. The results demonstrated that *S. indica* flowers possess significant antioxidant activity, as evidenced by a DPPH radical scavenging IC_{50} value of 32.29 ± 5.00 mg L^{-1}, compared to the positive control (7.90 ± 0.10 mg L^{-1}). The extracts also exhibited strong ferric reducing capacity, with a FRAP value of 1693.51 ± 27.05 µmol $FeSO_4$ g^{-1}, closely comparable to the positive control (1692.19 ± 0.01 µmol $FeSO_4$ g^{-1}). Furthermore, *S. indica* showed remarkable α-glucosidase inhibitory activity, 99 ± 0.33% inhibition at a concentration of 1000 mg L^{-1}. *E. subumbrans* flower extracts exhibited weak antioxidant activity, with a FRAP value of 310.98 ± 8.18 µmol $FeSO_4$ g^{-1} and DPPH IC_{50} value of 469.49 ± 10.54 mg L^{-1}, when compared to the respective positive controls. In the cytotoxicity assay, *S. indica* exhibited weak cytotoxic potential, with an LC_{50} value of 696.01 ± 30.66 mg L^{-1}, compared to the positive control, potassium dichromate ($K_2Cr_2O_7$), which had an LC_{50} of 7.93 ± 1.06 mg L^{-1}. Similarly, *E. subumbrans* also displayed weak cytotoxic activity in this assay. In the lettuce seed germination assay, both *S. indica* and *E. subumbrans* flower extracts exhibited weak phytotoxic activity at a concentration of 1000 mg L^{-1}. In conclusion, the notable antioxidant capacity and strong α-glucosidase inhibitory activity suggest that *S. indica* flowers warrant further investigation for potential applications in pharmaceutical development.

Keywords: *Antidiabetic, DPPH, FRAP, Medicinal flowers*

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In vitro bioactivity evaluation of leaf extracts of Sri Lankan plants *Osbeckia octandra* and *Crotalaria pallida Aiton*

H.M.D.D. Karunadasa[1], H.A.K.D. Premasiri[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

The rising demand for natural alternatives to synthetic herbicides and therapeutic agents has prompted research into plant-derived bioactive compounds. This study aimed to evaluate the biological activities of methanolic leaf extracts of *Osbeckia octandra* and *Crotalaria pallida Aiton*. Shade-dried, powdered leaf material was subjected to ultrasonic-assisted extraction using methanol, and crude extracts were concentrated using rotary evaporation. Antioxidant activity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and Ferric Reducing Antioxidant Power (FRAP) assay. Phytotoxic and cytotoxic potentials were evaluated using the lettuce (*Lactuca sativa*) seed germination assay and brine shrimp (*Artemia salina*) lethality bioassay, respectively. Enzymatic inhibition assays targeting α-amylase, α-glucosidase, and pancreatic lipase were performed only for *O. octandra* at a concentration of 1000 mg L^{-1}. *O. octandra* showed strong DPPH radical scavenging activity (IC_{50} = 9.39 ± 0.09 mg L^{-1}) compared to *C. pallida* (IC_{50} = 483.80 ± 10.10 mg L^{-1}) and ascorbic acid (IC_{50} = 7.90 ± 0.10 mg L^{-1}). The FRAP values were recorded as 1.75 ± 0.13 mmol Fe^{2+}/g for *O. octandra*, 0.49 ± 0.02 mmol Fe^{2+}/g for *C. pallida*, and 1.26 ± 0.01 mmol Fe^{2+}/g for Trolox. Phytotoxicity assay showed weak shoot and root inhibition in *O. octandra*, while *C. pallida* had moderate activity (Minimum inhibition concentration (MIC) between 250 – 500 mg L^{-1}; positive control: abscisic acid 10 mg L^{-1}). *C. pallida* also exhibited notable cytotoxicity (LC_{50} = 20.03 ± 2.05 mg L^{-1}) compared with *O. octandra* and $K_2Cr_2O_7$ as positive control (LC_{50} = 7.90 ± 0.10 mg L^{-1}). *O. octandra* showed strong α-glucosidase (99.92 ± 0.13%) inhibition compared to acarbose (88.97 ± 0.22%) and α-amylase inhibition (65.32 ± 3.08%) compared to acarbose (57.51 ± 4.33%) as the positive control. Lipase inhibition of *O. octandra* was lower (16.51 ± 5.27%) than orlistat (68.00 ± 14.53%) as the positive control. These findings suggest *O. octandra* may serve therapeutic roles, while *C. pallida* shows herbicidal potential, and further investigation could explore potential for development into natural herbicides and therapeutic agents.

Keywords: *Antioxidant activity, cytotoxicity, enzyme inhibition, phytotoxicity*

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Phytochemical and pharmacological profiling of *Nymphoides hydrophylla* leaves, flowers, and roots

M.M.H.S. Abeysinghe[1], Y.G.A.D.K. Bandara[1], D.S. Jayaweera[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

The increasing demand for novel, plant-based therapeutics has led to the exploration of bioactive compounds in medicinal plants. This study investigates the antioxidant, antidiabetic, cytotoxic, and phytotoxic activities of methanolic extracts obtained from the leaves, flowers, and roots of *Nymphoides hydrophylla* (locally known as Kumudu), an aquatic medicinal plant. Standardized bioassays were employed, including the Ferric Reducing Antioxidant Power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assays for antioxidant activity, the α-glucosidase inhibition assay for antidiabetic potential, the brine shrimp lethality assay for cytotoxicity, and the lettuce seed (*Lactuca sativa*) germination assay for phytotoxicity. Plant materials were cleaned, shade-dried, powdered, and extracted with methanol using ultrasonication. The resulting extracts were filtered, concentrated via rotary evaporation, and vacuum-dried. FRAP analysis revealed that the leaf extract exhibited the highest antioxidant activity (683.38 ± 0.03 µmol $FeSO_4$ g^{-1}), followed by the flower (641.95 ± 0.08 µmol $FeSO_4$ g^{-1}) and root extracts (65.62 ± 0.01 µmol $FeSO_4$ g^{-1}), in comparison to the standard Trolox (1692.19 ± 0.10 µmol $FeSO_4$ g^{-1}). In the DPPH assay, the floral extract demonstrated the strongest radical scavenging activity ($IC_{50} = 123.95 \pm 8.56$ mg L^{-1}), followed by leaves (213.05 ± 4.17 mg L^{-1}) and roots (553.28 ± 3.48 mg L^{-1}), all less effective than the positive control, ascorbic acid ($IC_{50} = 7.90 \pm 0.10$ mg L^{-1}). The leaf extract showed moderate α-glucosidase inhibitory activity (53.94 ± 1.22%), compared to the reference inhibitor, acarbose (76.67 ± 0.46%). In the brine shrimp lethality assay, both the leaf ($LC_{50} = 654.26 \pm 27.21$ mg L^{-1}) and floral ($LC_{50} = 159.19 \pm 28.81$ mg L^{-1}) extracts demonstrated low cytotoxicity relative to potassium dichromate ($LC_{50} = 7.97 \pm 0.97$ mg L^{-1}). Phytotoxicity testing at 1000 mg L^{-1} revealed that the floral extract exerted the strongest inhibitory effect on lettuce seedling growth, with root and shoot inhibition rates of 84.23 ± 2.24% and 47.98 ± 9.67%, respectively. The leaf extract inhibited root and shoot growth by 73.17 ± 8.66% and 21.34 ± 0.40%, while the root extract showed limited activity, with 24.09 ± 4.30% root inhibition and no significant effect on shoot growth. The minimum inhibitory concentration (MIC) of the positive control, abscisic acid, was effective at concentrations as low as 5–10 ppm. These findings suggest that *N. hydrophylla*, particularly its leaves and flowers, exhibits antioxidant, antidiabetic, and phytotoxic properties, encouraging further investigation into its bioactive constituents for pharmaceutical and agrochemical applications.

Keywords: *α-glucosidase inhibition, DPPH assay, FRAP assay, Phytotoxicity, Cytotoxicity*

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Comparative *in vitro* evaluation of antioxidant, cytotoxic, antidiabetic, and phytotoxic activities of *Annona reticulata* L. plant parts

H.W.D.K. Hathurusinghe[1], Y.G.A.D.K. Bandara[1], D.S. Jayaweera[1], K.G. Nelum.P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Annona reticulate L (commonly known as custard apple) is well recognized for its traditional use in medicine; however, the comparative evaluation of its different parts has received limited scientific attention. This study investigated the antioxidant, antidiabetic, cytotoxic, and phytotoxic activities of methanolic extracts of leaves and seeds, as well as aqueous extracts of fruit pulp. Antioxidant capacity was evaluated by ferric reducing antioxidant power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assays. Cytotoxicity was evaluated by the brine shrimp lethality bioassay while antidiabetic activity was determined using α-amylase inhibition assay. Phytotoxicity was evaluated through a lettuce seed (*Lactuca sativa*) germination bioassay. Among the tested samples, the leaf extract demonstrated the highest antioxidant activity, with a FRAP value of 1254 ± 32 µmol Fe^{2+}/g, which was nearly comparable to the standard antioxidant Trolox (1261 ± 11 µmol Fe^{2+}/g). It also exhibited moderate DPPH radical scavenging activity (IC_{50}: 132.6 ± 3.94 mg/L), compared with the positive control, ascorbic acid (IC_{50}: 7.90 ± 0.10 mg/L). In the cytotoxicity assay, the leaf extract showed substantial activity (LC_{50}: 0.5239 ± 0.2418 mg/L) and moderate phytotoxic effect, with 48.09% root growth inhibition at 1000 mg/L. The seed extract showed the strongest cytotoxicity (LC_{50}: 0.0610 ± 0.000 mg/L), exceeding that of the positive control. It also displayed moderate antioxidant potential (FRAP: 574 ± 8 µmol Fe^{2+}/g), but showed lower phytotoxicity compared to the leaf extract. The fruit pulp extract recorded the lowest antioxidant activity (FRAP: 274 ± 25 µmol Fe^{2+}/g) and exhibited mild cytotoxicity, with only 10% lethality at 1000 mg/L. It showed moderate α-amylase inhibitory activity (13.45 ± 4.76%), which was lower than that of the standard antidiabetic agent acarbose (59.82 ± 4.10%). In summary, the leaf extract showed notable antioxidant and moderate phytotoxic potential, making it a candidate for antioxidant and allelopathic research. The seed extract may be valuable in therapeutic or anticancer research due to its high cytotoxicity. The fruit pulp extract, though weaker overall, shows mild cytotoxic and antidiabetic activities. These findings support the need for further isolation and characterization of bioactive compounds from different parts of A*nnona reticulata* for pharmaceutical and agricultural applications.

Keywords: *Annona reticulata α-amylase inhibition, antioxidant activity, cytotoxicity, medicinal plant extract, phytotoxicity*

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Comparative evaluation of antioxidant, enzyme inhibitory, cytotoxic, and phytotoxic activities of *Olax zeylanica* and *Hygrophila auriculata* leaf extracts

K.V.P. Gunathilake[1], Y.G.A.D.K. Bandara[1], D.S. Jayaweera[1], N.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Sri Lanka has a vast variety of medicinal plants. Among them, *Olax zeylanica* (Mella) and *Hygrophila auriculata* (Neeramulliya/Ikiriya) are used for various treatments in traditional medicine. This study comparatively evaluated the antioxidant, α-glucosidase inhibitory, cytotoxic, and phytotoxic activities of the methanol leaf extracts from these two species. The leaves of the plants were collected from the Kegalle District, Sri Lanka. The collected samples were thoroughly cleaned, air-dried, and ground into a fine powder. The powdered samples were extracted into methanol by ultrasonication, and the solvent was evaporated to dryness. These crude extracts were evaluated for their antioxidant activities with 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and ferric reducing antioxidant power (FRAP) assays., Enzyme inhibitory activity against α-glucosidase, cytotoxicity with brine shrimp lethality assay, and phytotoxicity with lettuce seed (*Lactuca sativa*) germination assay. *O. zeylanica* demonstrated a stronger antioxidant activity (IC50 = 4.65 ± 0.42 ppm) than the positive control, ascorbic acid (IC50 = 7.90 ± 0.10 ppm), while *H. auriculata* showed comparatively moderate activity (IC50 = 40.75 ± 1.03 ppm). In the FRAP assay, both extracts showed high reducing power of 1666.19 ± 21.53 µmol $FeSO_4$/g for *O. zeylanica* and 1674.61 ± 15.43 µmol $FeSO_4$ g-1 for *H. auriculata* compared to the positive control, Trolox 1692.19 ± 0.10 µmol $FeSO_4$ g-1. *O. zeylanica* demonstrated a strong α-glucosidase inhibitory activity of 98.99 ± 0.13% at 1000 ppm, whereas *H. auriculata* showed a moderate inhibition of 52.97 ± 2.89% at the same concentration. In the brine shrimp lethality assay, *H. auriculata* exhibited weak toxicity, whereas *O. zeylanica* showed moderate activity with an LC50 of 824.97 ± 1.75 ppm. At of 1000 ppm, *H. auriculata* exhibited lettuce root growth inhibition at 39.22 ± 8.83 %, whereas *O. zeylanica* demonstrated comparatively lower inhibition at 14.88 ± 3.96 %. Neither extract showed notable inhibitory effects on shoot growth. These findings suggest that *O. zeylanica* has strong antioxidant potential with possible anticancer benefits. *O. zeylanica* exhibited potent α-glucosidase inhibition activity, which has potential as an antidiabetic agent. Future studies will focus on isolating and characterizing the bioactive compounds responsible for these activities.

Keywords: *Antidiabetic, antioxidant, cytotoxicity, Hygrophil auriculata, Olax zeylanica*

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Investigating the Bioactive Properties of Traditional Medicinal Plants: Emphasis on *Eleusine indica* and *Mimosa pudica*

K.H.S.T. Nanayakkara[1], Y.G.A.D.K. Bandara[1], D.S. Jayaweera[1], K.G. Nelum P. Piyasena[1*], N.K.B. Adikaram[1], L. Jayasinghe[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*

[*]*nelum.pi@nifs.ac.lk*

Medicinal plants have long been integral to both traditional and modern healthcare systems due to their rich repertoire of bioactive compounds with therapeutic potential. This study investigates the in vitro bioactivities of *Eleusine indica* (Goosegrass) and *Mimosa pudica* (Shameplant), two medicinal plants traditionally used in Sri Lanka. Leaf samples were collected from the Kandy District, cleaned, shade-dried, powdered, and subjected to methanolic extraction. The antioxidant potential of the crude extracts was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and Ferric Reducing Antioxidant Power (FRAP) assay. Cytotoxicity was assessed via the brine shrimp lethality bioassay, and phytotoxicity was determined using the lettuce seed (*Lactuca sativa*) germination assay. In the DPPH radical scavenging assay, *M. pudica* exhibited strong antioxidant activity (IC_{50} =13.45 ± 0.51 mg/L), while *E. indica* showed weak activity (IC_{50} = 503.98 ± 18.33 mg/L). The positive control, ascorbic acid, exhibited potent antioxidant activity with an IC_{50} value of 7.90 ± 0.10 mg/L.Similarly, in the FRAP assay, *M. pudica* exhibited greater ferric reducing power (1526.10 ± 38.15 µmol Fe^{2+} g^{-1}) compared to *E. indica* (295.09 ± 7.38 µmol Fe^{2+} g^{-1}), both assessed relative to the standard antioxidant, Trolox (17679.67 ± 505.58 µmol Fe^{2+} g^{-1}). Cytotoxicity assessment revealed notable lethality for both species, with *E. indica* and *M. pudica* displaying LC_{50} values of 3.46 ± 0.09 mg L^{-1} and 2.33 ± 0.07 mg L^{-1}, respectively both exhibiting higher toxicity than the positive control, potassium dichromate (LC_{50} = 7.97 ± 0.97 mg L^{-1}). In phytotoxicity testing, *E. indica* inhibited root growth (IC_{50} = 32.47 ± 0.81 µg mL^{-1}) but showed no significant effect on shoot growth. Conversely, *M. pudica* inhibited both root (IC_{50} = 52.02 ± 1.30 µg mL^{-1}) and shoot (IC_{50} = 9.33 ± 0.23 µg mL^{-1}) development. Overall, *M. pudica* demonstrated higher antioxidant and phytotoxic properties compared to *E. indica*, while both extracts showed potent cytotoxicity. These findings support the potential pharmaceutical applications of these species, warranting further studies focused on the isolation, characterization, and pharmacological evaluation of their bioactive constituents.

Keywords: *Antioxidant, cytotoxicity DPPH assay, FRAP assay, phytotoxicity*

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Comparative construction and analysis of colour magnitude diagrams for seven diverse globular clusters

R.M.B.M.B. Alawathugoda[1], N.I. Medagangoda[2], S. Kandeepan[1], M.L.C. Attygalle[1]*

[1]*Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Arthur C. Clarke Institute for Modern Technologies, Katubedda, Sri Lanka*

[*]*lattygalle@sjp.ac.lk*

The construction and comparative analysis of Colour-Magnitude Diagrams (CMDs) are fundamental to understanding the populations and evolution of stars in globular clusters (GC's). This study aims to construct and analyse CMDs for seven GC's, NGC 1866, NGC 2419, NGC 6388, NGC 1783, NGC 1978, NGC 121, and NGC 419, with the objective of investigating how age, metallicity, and galactic environment affect stellar evolutionary features. High-resolution photometric data, primarily obtained from the Hubble Space Telescope (HST) in the F438W, F555W, F606W, and F814W bands, were processed using Point Spread Function (PSF) photometry to resolve stars accurately in both crowded and sparse fields. Calibrated photometric catalogues were cross-matched and cleaned. CMDs were plotted for each cluster, revealing significant diversity in stellar evolutionary features such as the Main Sequence (MS), Main Sequence Turn-Off, Red Giant Branch (RGB), and Horizontal Branch (HB). NGC 1866, located in the Magellanic Clouds, is the youngest cluster in the sample and displays prominent primary sequences and extended turn-off regions indicative of multiple stellar populations. In contrast, NGC 2419 is an old metal-poor cluster, while NGC 6388 is metal-rich; both exhibit well-developed horizontal and red giant branches, with NGC 6388 notably showing a blue horizontal branch despite high metallicity. Intermediate-age clusters such as NGC 1783, NGC 1978, and NGC 419 show well-populated red clumps and subtle differences in giant branch morphology. NGC 121, the oldest cluster in the Small Magellanic Cloud, features a classic HB and narrow MS. These CMDs provide valuable benchmarks for theoretical stellar evolution models, highlighting environmental and intrinsic factors shaping cluster evolution. Unlike previous studies, this work offers a direct comparison across diverse environments using consistent photometric methods. These CMDs serve as benchmarks for evolution models, highlighting environmental and influences on cluster evolution. Future research will integrate spectroscopic metallicities and expand the cluster sample to enhance globular cluster formation and evolution models.

Keywords: *Evolutionary features, Hubble Space Telescope, point spread function, stellar evolution, stellar populations*

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Factors influencing grade 10 students' mathematical performance: A comprehensive analysis in Sri Lankan government schools

A.M. Dilushika[1*], R.P.D.C.S. Devindi[2], H.W.B. Kavinga[1]

[1]*University of Kelaniya, Kelaniya, Sri Lanka*
[2]*University of Wisconsin–Whitewater, Whitewater, USA*

[*]*dilushikaanton@gmail.com*

Mathematics serves as a universal language that transcends boundaries, connecting people across diverse backgrounds. It is a mandatory requirement for students to pave their path towards higher education, posing challenges for many Sri Lankan students. This is the first study to examine foundational mathematical knowledge and factors influencing performance among Grade 10 students in the Colombo educational zone. From a population of 11,972 students across 108 government schools, a sample of 373 students from 12 schools was included based on performance levels. Data was collected using a questionnaire covering the major areas: Arithmetic, Algebra, Geometry, and Sets & Probability. The analysis involved descriptive statistics, inferential tests, and regression analysis. The descriptive analysis uncovers that many students struggle with fundamental operations such as fraction division, decimal calculations, applying the order of operations (BODMAS), factorisation, solving simultaneous equations and probability. The Wilcoxon Rank-Sum Test and Kruskal-Wallis Test identified performance differences across various factors. Significant performance differences were observed among male and English-medium students, those from higher-income or highly educated families, students with strong interest in mathematics, involvement in extracurricular activities or private tutoring, supportive home environments, and negative attitudes toward the subject. Moreover, Hierarchical multiple regression showed that all blocks, except environmental factors, significantly improved R-squared. Since multiple linear regression analysis revealed a violation of the constant variance assumption, a Weighted Least Squares (WLS) model was employed, which satisfied all the necessary model assumptions. The WLS model indicated that higher family income, a strong preference for mathematics, involvement in clubs and societies, success in the Grade 5 scholarship examination, and higher levels of general knowledge and IQ significantly enhanced students' mathematical performance. Conversely, perceiving mathematics as a very difficult subject compared to others was associated with lower performance in mathematics. Future studies could explore targeted strategies to enhance students' performance in mathematics.

Keywords: *Hierarchical multiple regression, kruskal-wallis, regression, weighted least squares (wls), wilcoxon rank-sum.*

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Stochastic volatility and leverage analysis in the foreign exchange market using Bayesian model

H.R.I. Perera[1*], U.P. Liyanage[2]

[1]*Department of Statistics & Computer Science, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka*
[2]*Department of Mathematics, Faculty of Science, University of Colombo, Colombo, Sri Lanka*

[*]*ruwanthap2000@gmail.com*

The foreign exchange (forex) market, as the most liquid and actively traded financial market globally, is shaped by global economic activities, geopolitical events, and policy changes, making it highly dynamic and complex. To navigate such conditions effectively, technical analysis explores market-specific features such as stochastic volatility, momentum, and the leverage effect. This study's main objective is to examine the interaction between stochastic volatility and the leverage effect to better understand their impact on forex market dynamics. In this study, the Bayesian model developed by Zhang is utilized and extended to forex market data, providing a novel application that has not been examined in previous research. The approach starts with a basic stochastic volatility model and extends it by incorporating leverage through correlation between return and volatility errors. The Bayesian test statistic is then used to assess the leverage effect. The key computational challenge lies in obtaining the first derivatives of the observed data likelihood function concerning model parameters, as its closed form is typically unavailable. To address this, Markov Chain Monte Carlo (MCMC) simulation outputs and Cholesky decomposition are used to approximate them efficiently, enabling hypothesis testing. The methodology was applied to daily returns of the Euro/Dollar and Euro/Pound exchange rates from January 2, 2024, to January 2, 2025, with further analysis exploring the relationship between leverages and the Bayesian test statistic. Larger absolute leverage values, especially +1 and -1, caused a rapid rise in the test statistic, highlighting a strong leverage effect and the model's sensitivity to leverage in influencing volatility dynamics. These results highlight the need to incorporate the leverage effect into stochastic volatility models to improve accuracy in capturing forex market behaviour and enhance volatility forecasting and risk management. Future research can extend this approach to other financial markets to further validate and compare the findings.

Keywords: *Bayesian test statistic, FOREX market, leverage effect, markov chain monte carlo (mcmc), stochastic volatility models*

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Assessing digital and managerial enablers of remote work in Sri Lanka's public sector

G.P.R.T. Pathirana[1], D. Hewawasam[1*], I. Perera[1]

[1]*University of Moratuwa, Katubedda, Sri Lanka*

[*]*dasunihhs.22@uom.lk*

The COVID-19 pandemic resulted in a broad adoption of Work-from-Home (WFH) globally. However, public institutions in Sri Lanka had varied levels of digital maturity and preparedness at the management level, which made it challenging to maintain operational effectiveness during this shift. Understanding these factors is essential for guiding future remote work strategies. The objective of this study is to determine the impact of five organizational and technological factors, such as IT training, digital infrastructure, management support, digital orientation, and digital capacity, on the effectiveness of WFH in public sector institutions in Sri Lanka. This study tested the hypotheses that each of the five factors would positively influence WFH effectiveness. A quantitative, positivist research methodology was employed. Data were collected using a structured questionnaire by 50 employees across diverse public sector organizations in Colombo. Responses were measured on a Likert scale and analysed using SPSS for descriptive statistics, Pearson correlation, and linear regression to examine the strength and significance of relationships between variables. The reliability of the approach was examined via Cronbach's alpha. The findings show statistically significant positive correlations between all five independent variables and WFH effectiveness. Among these five variables, digital capacity and management support emerged as the strongest predictors. Respondents with appropriate IT training and reliable access to digital infrastructure reported higher productivity and engagement when they WFH. The Cronbach's alpha value came to a strong value of 0.904, which indicates that this method is reliable. This study confirms that organizational readiness exists in both digital capacities and managerial support, which has a crucial influence on the success of WFH. These findings enable policymakers to apply more resilient, inclusive, and effective practices to WFH policies in public administration. Future research could extend the analysis to other contexts, use longitudinal designs, and explore moderating effects of leadership style or organizational culture.

Keywords: *Digital capacity, digital infrastructure, IT training, management support, work from home*

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A refined approach for multi-objective balanced and unbalanced assignment problems

S.B.R.D. Dhananjalee[1*], E.M.U.S.B. Ekanayake[1]

[1]*Department of Physical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Sri Lanka*

[*]*dinushidhananjalee@gmail.com*

This paper proposes an advanced solution to multi-objective balanced and unbalanced assignment problems using the hybridization of statistical normalization with a hybrid optimization algorithm. The Multi-Objective Assignment Problem (MOAP) is a non-deterministic polynomial-time hard combinatorial optimization problem where multiple, often conflicting, objectives such as cost, time, and quality should be optimized simultaneously while allocating tasks or resources to agents or locations. Existing MOAP methods can become difficult to handle as the number of objectives increases, motivating the need for a more efficient and understandable approach. This study aims to develop a statistically normalized hybrid heuristic to improve solution quality and trade-off balance in multi-objective assignment problems. The proposed method begins with the calculation of the objective matrices for each criterion. For each matrix, the arithmetic mean and standard deviation are computed to normalize the values to cumulative distribution functions (CDFs) according to the normal distribution. The CDF-transformed matrices are then grouped into an individual aggregated matrix through taking the arithmetic mean of the corresponding elements. For calculation of optimal assignment, a geometric-mean-based iterative approach is employed column wise and row wise. With this hybrid process, there exists an optimal and healthy trade-off among all the objectives and provides a stable and comprehensible solution. The method is shown to be effective with benchmark numerical examples, and the results demonstrate superior performance in the generation of optimal assignments compared to other methods. Numerical illustrations further reveal that the proposed method effectively reduces the overall objective function values compared to existing approaches, highlighting its efficiency in handling multiple conflicting objectives. Future research will focus on extending the proposed approach to larger-scale and dynamic assignment problems.

Keywords: *Balanced and unbalanced assignment problems, cumulative distribution functions, geometric mean, multi-objective assignment problem, normal distribution*

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Energy-Efficient Spectrum Access Using Deep Q-Networks in IoT-Based Cognitive Radio Networks

S. Jayasinghe[1*], M.W.P. Maduranga[2]

[1]*University College of Ratmalana, University of Vocational Technology, Ratmalana, Sri Lanka,*
[2]*University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

[*]*surath@ucr.ac.lk*

Efficient spectrum utilization and energy management are critical challenges in Internet of Things (IoT)-based cognitive radio networks, where rapidly increasing device density intensifies competition for limited spectrum resources. Conventional heuristic and rule-based spectrum access strategies lack adaptability to dynamic channel and traffic variations, resulting in poor energy efficiency and reduced network lifetime. To address these issues, this research adopts a reinforcement learning (RL) framework, enabling IoT devices to learn optimal transmission policies through continuous interaction with their environment without prior knowledge of network conditions. This study presents a Deep Q-Network (DQN)-based approach for energy-efficient and intelligent spectrum access in IoT-based cognitive radio networks. Leveraging reinforcement learning, the proposed method dynamically selects optimal transmission channels and power levels for heterogeneous IoT devices operating under energy constraints. A software-based simulation was carried out, creating a cognitive radio environment with 10 low-power IoT sensors and 5 spectrum channels, each supporting three discrete power levels (Low, Medium, High), forming a 15-dimensional state-action space. The DQN agent employs an ε-greedy strategy for exploration, updates Q-values using the Bellman equation, and incorporates experience replay for stable convergence. The reward function is designed to balance successful packet delivery and energy efficiency, penalizing excessive power usage. Results demonstrate that the DQN-based method significantly outperforms conventional spectrum access techniques and maintains scalability with more devices and channels. Overall, the proposed approach provides an adaptive and energy-efficient spectrum management framework, outperforming heuristic methods and contributing to the development of intelligent IoT communication systems.

Keywords: *Energy consumption, packet delivery ratio (PDR), reward function, spectrum efficiency, spectrum utilization efficiency*

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A new shrinkage-based estimator for logistic regression under multicollinearity: The James-Stein logistic Liu estimator (JSLLE)

T. Kayathiri[1*], M. Kayanan[2], P. Wijekoon[3]

[1]*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka,*
[2]*Department of Physical Science, University of Vavuniya, Sri Lanka,*
[3]*Department of Statistics and Computer Science, University of Peradeniya, Sri Lanka*

[*]*skayathiri1994@gmail.com*

Logistic regression is a widely used method for analyzing binary outcomes in various fields, including healthcare and finance. The Maximum Likelihood Estimator (MLE) is the standard technique for estimating parameters in logistic regression. However, when predictor variables exhibit multicollinearity, MLE becomes inefficient, leading to inflated variances and unstable coefficient estimates. To address this issue, several biased estimators have been proposed in the literature, including the James-Stein Estimator (JSE) and the Logistic Liu Estimator (LLE). This study introduces a new estimator, the James-Stein Logistic Liu Estimator (JSLLE), which combines the shrinkage properties of JSE with the flexible biasing mechanism of LLE. We explore two distinct shrinkage values based on existing literature, resulting in two variants of the estimator: JSLLE1 and JSLLE2. The primary objective is to enhance the accuracy of parameter estimation in logistic regression using JSLLE by minimizing the Scalar Mean Squared Error (SMSE). A Monte Carlo simulation study was conducted to assess the performance of MLE, JSE, LLE, and JSLLE under moderate to high multicollinearity and sample sizes ranging from small to large. The findings indicate that JSLLE outperforms MLE, JSE, and LLE for moderate sample sizes with moderate to high multicollinearity. The relative efficiency of JSLLE1 compared to MLE based on SMSE shows clear improvement across different correlation levels and sample sizes. For correlation values of 0.5, 0.7, and 0.9, JSLLE1 achieves efficiencies of 30.83%, 39.28% and 55.81% for n=50; 19.73%, 24.07% and 39.46% for n=100; and 2.61%, 3.61% and 9.29% for n=1000. The corresponding efficiencies of JSLLE2 are 28.32%, 33.99%, and 47.53%; 17.72%, 23.45%, and 38.03%; and 2.58%, 3.62%, and 9.53%, respectively. Overall, the efficiency of the proposed estimator increases with higher correlation, demonstrating its robustness and practical value in addressing multicollinearity, making JSLLE a reliable and efficient alternative for logistic regression analysis.

Keywords: *Biased estimation, binary response, maximum likelihood estimator, scalar mean squared error, simulation study.*

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Modelling epidemic spread through temporal social networks: Insights from graph theory and mobility data

W.T. Pramodhya[1*], G.J. Lanel[1], M.H.L. Weerasinghe[2], T.M.M. De Silva[2]

[1]*University of Sri Jayewardenepura, Sri Lanka*
[2]*University of Kelaniya, Sri Lanka*

[*]*wevitagetp@gmail.com*

Controlling the spread of social network diseases and uncovering their dynamic processes is a profound scientific challenge. Traditional models treat populations as mixed systems, and social networks, movement patterns, and temporal relationships are fundamental factors influencing disease spread. Therefore, mathematical and graph-aggregated methods are needed to identify and control disease dynamics. The key objective of this study is to use graph theory for complex network structure analysis to develop a mathematical model for identifying and controlling the dynamics of epidemic spreading. Since the required data was not available in the literature, a network was created with hypothetical data close to reality. The relationship weights based on travel data between city centres were determined using the min-max normalisation approach. Furthermore, the developed network's degree centrality, modularity, and community structure were examined as graph properties. To specifically identify changes in temporal social relationships, two temporal modularity models (Rewarded and Penalised) were developed. Rewarded Modularity recognises constructive improvements; Penalised Modularity penalises social structure instability. According to the model mentioned above, if social groupings are stable, focused control measures can be implemented when appropriate; if not, Edge Dynamics Analysis should analyse the relationships between social groups, identify the risk of disease spread within the community, and take the necessary control measures. Decreasing modularity values indicate an increase in the rate of disease spread. When $\lambda = 0.5$, Penalised Temporal Modularity is 0.525, and community structure becomes more stable. The Reward Temporal Modularity was 1.475 and it helped identify 'bridge nodes' and trace the spread of the disease. This study emphasises how critical it is to use insights from temporal graph theory in epidemic control. The use of temporal relationship graph theory is very important in disease control, and real-time data analysis can provide more reliable conclusions about disease spread and more efficient control strategies.

Keywords: *Complex networks, epidemic control, epidemic spreading, graph theory network dynamics, temporal modularity*

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Design, implementation and evaluation of an interactive web-based quiz platform for large-scale learning environments

H.K.D.U.S. Perera[1*], P.S. Dolawaththa[2]

[1]*Department of Computing & Technology, Faculty of Computing, Saegis Campus, Nugegoda, Sri Lanka*
[2]*Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka*

**udayaperera2012@gmail.com*

The increasing integration of digital technologies in education has highlighted the need for effective, accessible, and scalable tools to support student learning and assessment. Traditional quiz systems often impose limitations on participation size, question input methods, or accessibility, which restrict their suitability for large-scale educational contexts. This study focuses the design, implementation, and evaluation of an interactive, free, and open-source web-based quiz platform aimed at enhancing student knowledge through real-time assessments with unlimited participation. The work is justified by the current lack of free and open access quiz tools that can efficiently handle large-scale usage while ensuring accessibility and flexibility for educators. The system was developed using the Spiral Model, employing modern web technologies such as JavaScript, Firebase, and Bootstrap. It supports both manual and bulk question uploads, real-time monitoring, and open customization by institutions. Methodologically, the system underwent usability testing with teachers and students from secondary and higher education institutions and performance benchmarking under multiuser conditions to validate its functionality. Quantitative analysis indicated that 90% of teachers rated the system's usability 4 or higher on a 5-point scale, and the platform maintained average response times below three for over 150 concurrent users, confirming high scalability and reliability. Compared with commercial platforms like Kahoot, the proposed solution offers full opensource accessibility, unrestricted user capacity, and easier customization for academic institutions. Lecturers appreciated the ability to create quizzes and view live performance analytics, while students reported improved engagement and comprehension. The validated findings confirm that the platform effectively enhances both learning and assessment processes. Future developments will include multimedia question types, data-driven learning analytics dashboards, and integration with learning management systems to expand its pedagogical impact.

Keywords: *Accessibility, assessment, engagement, scalability, usability.*

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A variant of ElGamal cryptosystem using Cayley graph with shortest path masking

P.G.R.S. Ranasinghe[1*], S.C. Aryarathna[1]

[1]*University of Peradeniya, Peradeniya, Sri Lanka*

**s19314@sci.pdn.ac.lk*

Since its introduction in 1985, the ElGamal cryptosystem has played a foundational role in public-key cryptography. However, it is increasingly vulnerable to advances in computational power. Acknowledging that absolute trust in any single algorithm is untenable, the present study introduces a novel variant that integrates Cayley graph (CG) theory with Shortest Path Masking (SPM) to improve security, aiming to hide the link between plaintext and ciphertext using structural complexity beyond the usual discrete logarithm assumptions. Our methodology was designed to embed the message within a secondary hard problem. We selected a CG model constructed from public parameters ($p \equiv 3(mod\ 4)$, generator g) due to its rich, non-obvious combinatorial structure, which is ideal for masking. The core innovation is a SPM process: messages (m) are encoded by applying a novel transformation based on the sum (n) and length (l_1) of their shortest path in the CG ($m' \equiv m \cdot n^{l_1}(mod\ p)$). This mask and a related authentication tag (t) are integrated into a modified ElGamal encryption scheme. While the initial validation using a relatively smaller prime ($p = 127$) confirmed correctness, we have extended our analysis to security-relevant primes (e.g.,2048-bit). The preliminary results indicate that the SPM layer adds a modest computational overhead during encryption while substantially enhancing the cryptographic strength. Decryption performance remains comparable to that of standard ElGamal. From a security perspective, the graph-based transformation diversifies the underlying hard problem by coupling the discrete logarithm with a combinatorial path-finding problem. Our study presents a practical and strengthened cryptosystem that diversifies its security assumptions. By embedding a graph-theoretic challenge into ElGamal, we introduce a new barrier for adversaries, making our variant a more resilient choice against modern computational threats. Future research will focus on developing formal security proofs and extend SPM to Elliptic Curve Cryptography (ECC) and alternative graph families to optimize performance.

Keywords: *Authentication, discrete logarithm, graph theory, public-key, security*

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Assessing farmers' climate change awareness and adaptive behaviour in Sri Lanka: A partial least squares structural equation modelling approach

S.P. Fernando [1], I. J. A. Ruhunuge[1,2 *], M.S.D. Perera[3], S.A.K.B. Senarath[1], K.K.M. Apsara[1]

[1]*Data Management Division, Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo 07, Sri Lanka*
[2]*Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka*
[3]*Department of Census and Statistics, Colombo 05, Sri Lanka*

**isuriruhunuge999@gmail.com*

Climate change poses a major threat to Sri Lanka's agriculture, which is predominantly rain-fed and supports livelihoods and food security. This study provided novel empirical evidence on farmers' awareness and adaptive behaviour towards climate change using Partial Least Squares Structural Equation Modelling (PLS-SEM). This is among the first studies in Sri Lanka to apply PLS-SEM to analyse behavioural adaptation to climate change among farmers. Specifically, it examined how farmers' awareness influences the adoption of climate-smart practices and how education, risk perception, and demographic factors moderate these relationships. A structured survey was conducted among 200 farmers representing six major agricultural districts, purposively selected based on their vulnerability to climate change. The PLS-SEM results revealed that awareness of climate change had a significant and positive influence on the adoption of climate-smart practices, such as crop diversification, soil conservation, and improved irrigation ($\beta = 0.340$, $p < 0.001$). Education strengthened this relationship, while perceived risk positively affected awareness ($\beta = 0.141$, $p < 0.01$). Age showed a negative effect ($\beta = -0.105$, $p < 0.001$), indicating that older farmers showed higher awareness, whereas gender had no significant influence ($\beta = -0.009$, $p = 0.722$). The study concluded that addressing the gap between awareness and action through institutional support and community-based interventions is crucial for building climate resilience in Sri Lanka's agricultural sector. Although causal relationships were beyond the study's scope due to its cross-sectional design, the findings provided evidence to inform Sri Lanka's national climate adaptation strategy and support the design of targeted, region-specific interventions. Future research should explore causal pathways and region-specific barriers to adaptation using longitudinal or mixed-method approaches.

Keywords: *Adaptation, climate change awareness, climate literacy, food security*

Acknowledgement: The authors extended their gratitude to the farmers who participated in this study, sharing their valuable time and insights.

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Decadal spatial analysis of forest fire risk in the Badulla District, Sri Lanka

W.M.S.M. Wijekoon[1], G. Naveendrakumar[2], H.M.K. Kumarasingha[3*]

[1]*Department of Bio Sciences, Faculty of Applied Sciences, University of Vavuniya, Sri Lanka*
[2]*Department of Bio Sciences, Faculty of Applied Sciences, University of Vavuniya, Sri Lanka*
[3]*Central Environmental Authority, Badulla, Sri Lanka*

**sureshikam98@gmail.com*

Forest fires are a significant environmental threat to the central highlands of Sri Lanka, with profound implications for biodiversity conservation, ecosystem services, and local community livelihoods, particularly in Badulla District where topographic complexity, vegetation patterns, and intensifying anthropogenic pressures create heightened fire vulnerability. This research study presents a decadal spatial risk assessment and zonation mapping of forest fires in Badulla district through the integration of Geographic Information System with the Analytic Hierarchy Process over a ten year of fire incidents analysis period (2015-2024). A total of 87 historical fire incident locations obtained from the Forest Department of Badulla were analyzed alongside six critical spatial variables, land use/land cover, proximity to settlements, slope, aspect, relative humidity, and maximum temperature, with climatological data derived from twelve meteorological stations across the district. Using ArcGIS 10.8, each variable was systematically reclassified into five risk categories and integrated through expert weighted overlay analysis, where land use/land cover received the highest weighting (44%), followed by proximity to settlements (17%), slope (17%), aspect (7%), relative humidity (6%), and maximum temperature (9%), reflecting their relative importance in fire risk assessment. The composite Forest Fire Risk Index revealed that approximately 32% of the study area falls within high to very high-risk categories with Haldummulla and Ella region shows as most fire prone areas with the most vulnerability spotted in the central and southern regions.

Keywords: *Climate change, fire risk mapping, GIS, human activities, spatial modelling*

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Climate-based prediction of extreme PM_{10} concentration in valley-like geographical regions: a case study

M.A.V.R. Ashandi[1*], P.A.D.A.N. Appuhamy[1], E.M.P. Ekanayake[1], A.A.L. Disanayake[1]

[1]*Department of Mathematical Sciences, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka*

**raviniashandi97@gmail.com*

Air pollution poses a severe risk to both public health and ecosystems, intensified by human activities and climate changes. Climate variations could alter airborne pollutant composition at different rates, and their delayed nonlinear effects on extreme pollutant levels have been overlooked. This study focused on predicting extreme Particulate Matter (PM_{10}) concentration in a valley type geographical region in Sri Lanka, occurring at the tth hour based on immediate and lagged meteorological variables. Data comprised of 6648 hourly records over the period from October, 2022 to July, 2023. Having identified variations in PM_{10} concentration from descriptive statistics, Peak-over-Threshold approach of Extreme Value Theory was applied to isolate the extreme values. Those extremes at time t were then modelled using three machine learning techniques viz. Support Vector Regression (SVR), Random Forest (RF), and Extreme Gradient Boosting (XGBoost), based on meteorological data at t, t−1, t−2, and t combined with t−1 separately as input features. Predictive performances of all these twelve models were evaluated comparatively in terms of the Mean Absolute Percentage Error (MAPE), Root Mean Squared Error (RMSE), and the Coefficient of determination (R^2). A positive skewness and high kurtosis (> 3) indicated a heavy right -tailed distribution in hourly PM_{10} concentrations, confirming extreme PM_{10} events during the study period. A total of 456 extreme values were thus identified and subjected to modelling. The SVR excelled in achieving the highest accuracy with meteorological variables at t with MAPE, RMSE, and R^2 values of 3.72%, 0.015, and 0.980, followed by t−2 with 4.30%, 0.017, and 0.987 respectively. XGBoost emerged with competitive performance, particularly with immediate inputs, whereas RF showed lower predictive power overall producing its best with 2-hour delayed climatic variables. These findings help identify both immediate and delayed meteorological influences on extreme PM_{10} levels and aid in early warnings.

Keywords: *Air quality prediction, extreme value theory, lagged, support vector regression.*

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The analytical modelling, simulation and characterization of GaAs MOSFET with nanoparticles for advanced semiconductor applications Using MATLAB

A.L.N. Najaa[1*], M.J.M. Jafeen[1]

[1]*Department of Physics, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka*

[*]*noorlatheef12@gmail.com*

GaAs-based MOSFETs face persistent challenges in electrostatic control and thermal stability, prompting the integration of innovative materials and advanced device architectures. This study proposes a high-speed GaAs (Gallium arsenide) MOSFET structure incorporating silver nanoparticles, graphite coating, graphite electrodes, and a high-κ TiO_2 dielectric layer to address these limitations and enhance overall device performance. MATLAB simulations combining analytical equations with spatially resolved numerical modeling were implemented to solve the system self-consistently. Key electrical parameters such as threshold voltage, carrier mobility, electric field distribution, and I–V characteristics were analysed under varying operating conditions. The inclusion of silver nanoparticles in the semiconductor region improved electrostatic control by modulating electric field intensity and aiding thermal management through enhanced heat dissipation. Additionally, silver nanoparticles and graphite coating together reduced contact resistance, resulting in increased carrier mobility and improved current transport. The proposed device demonstrated a threshold voltage of approximately 0.87 V. A simulated drain current of 6.48 mA and transconductance of 275.76 mS cm^{-1} were obtained at a gate-to-source voltage(V_{GS}) of 1.2 V, with the device operating in the saturation region indicating enhanced carrier mobility and strong gate control. Efforts should be made to optimize low-cost and scalable fabrication methods, such as inkjet printing or Chemical Vapour Deposition(CVD), for mass production. As device dimensions approach the nanoscale, quantum effects such as tunnelling and confinement can be harnessed to develop advanced quantum FETs(QFETs). Since this study is simulation-based, experimental fabrication and validation are essential to evaluate real-world behavior, including the impact of fabrication imperfections and interface stability. Furthermore, the proposed device can be extended for use in analog amplifier circuits and high-sensitivity FET-based sensors. These results highlight the effectiveness of nanomaterial integration in overcoming key limitations of traditional MOSFET scaling, offering a promising pathway for the development of next-generation high-speed, low-power electronic devices.

Keywords: *Advanced device architectures, carrier mobility, contact resistance, thermal stability, threshold voltage.*

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Assessing chatbot use in disaster risk reduction: A review of global systems and a framework for disaster mitigation in Sri Lanka

W.S.H. Sawandi[1], N.S. Bandara[2], D.J. Jayasanka[3], B. Amila[4], P. Kalansooriya[5], A.B. Jayasinghe[2], C. Hewawasam[1*]

[1]*Department of Civil and Environmental Technology, Faculty of Technology, University of Sri Jayewardenepura*
[2]*Department of Town & Country Planning, University of Moratuwa*
[3]*Department of BioSystems Technology, Faculty of Technology, University of Sri Jayewardenepura*
[4]*Department of Materials and Mechanical Technology, Faculty of Technology, University of Sri Jayewardenepura*
[5]*Department of Computer Science, Faculty of Computing, KDU*

* *choolaka@sjp.ac.lk*

The growing frequency and severity of climate-induced disasters have heightened the importance of systems designed for disaster management to reduce their effects on human life. Chatbot technologies have emerged as valuable tools in the realm of digital advancements for disseminating disaster information. This study conducts a systematic review of 25 chatbot systems developed for disaster contexts. The search was conducted in January 2025 using Scopus and Web of Science databases, employing PICO-based search strings such as chatbot and other hazard-related terms. Essential analytical dimensions encompass disaster phase coverage, functional capabilities, technical architecture, usability, and validation. Results indicate that existing systems predominantly address the preparedness and response phases. Most chatbots primarily provide basic alert or FAQ functions, exhibiting limited interactivity and spatial intelligence. Critically, no systems currently support the mitigation phase, which necessitates informed risk analysis for decisions related to land acquisition, zoning, and building design for long-term disaster risk reduction. Most lack real-time validation, multilingual access, or adaptive learning mechanisms. To address that gap, the study proposes a conceptual framework for a mitigation-oriented chatbot tailored to the Sri Lankan context. The design combines a risk assessment engine that works on a schedule, a knowledge base, a manager for user preferences, a weather API, and tools for predicting risks. This system facilitates proactive inquiries, such as "Is this land safe to buy?" and provides guideline-based recommendations, and incorporates a feedback loop for learning from an expert. The framework offers an innovative foundation for intelligent, locally relevant disaster mitigation, advancing urban development resilience. The experimental deployment will initially be implemented in the Kalu Ganga river basin. To assess the test's efficacy, key performance indicators (KPIs) will be utilized.

Keywords: *Artificial intelligence, chatbot evaluation, human-ai interaction, geospatial analysis, user-centered design*

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Bayesian isochrone fitting of NGC 4147 globular cluster using F606W–F814W CMD to estimate age and cluster parameters

M.L.C. Piyumal[1*], D.N. Jayawardane[1], N.I. Medagangoda[2], S. Gunasekera[2]

[1]*Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Arthur C. Clarke Institute for Modern Technologies, Moratuwa, Sri Lanka*

**as20202485@sci.sjp.ac.lk*

Globular clusters are dense, gravitationally bound collection of stars that play a vital role in tracing the evolutionary history of the Milky Way. Estimating their ages and other fundamental parameters with precision is essential for constraining models of galactic formation and early universe evolution. This study focuses on NGC 4147, a high-latitude halo globular cluster, and presents a statistically robust method to estimate its stellar population parameters such as age, distance modulus, and metallicity using a colour-magnitude diagram (CMD). The analysis utilizes archival Hubble Space Telescope data obtained through the ACS/WFC instrument in the F606W and F814W passbands. Point Spread Function photometry was performed using the IRAF DAOPHOT package to extract stellar magnitudes in the crowded field. To find best-fitting cluster parameters a Bayesian isochrone fitting framework was applied to the CMD data using Markov Chain Monte Carlo sampling implemented via the *emcee* Python package. Unlike classical chi-square or maximum-likelihood methods, this approach allows to constrain multiple cluster parameters simultaneously and provides full posterior probability distributions for accurate uncertainty estimation. The isochrone grid was generated using Dartmouth Stellar Evolution Program (DSEP) isochrones. Stellar Reddening was fixed to a literature-based value for computational tractability. The CMD shows a well-defined main sequence and turnoff region, allowing a tight fit of the isochrone. The analysis yields an age of 11.35 ± 0.19 Gyr, a distance modulus of 16.99 ± 0.01, and a metallicity of [Fe/H] = –2.12 ± 0.05. This high-precision age estimation for one of the oldest known Galactic clusters contributes directly to refining the timeline of the Milky Way's formation. Results are consistent with literature values and demonstrate the reliability of using a Bayesian framework for simultaneous parameter estimation from photometric data alone. Computational expense of MCMC sampling can be prohibitive with increasing model complexity, and the results are susceptible to parameter degeneracies, notably the age-metallicity degeneracy. Future analyses will incorporate reddening as a variable parameter to refine the model.

Keywords: *Colour-magnitude diagram, Dartmouth isochrones, Hubble space telescope, MCMC, PSF photometry*

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Democratizing space science: a graduate student-led digital initiative reaching thousands across South Asia

W.C.S. Senarath[1*], R.M.I.M. Nandasena[2]

[1]*Institute of Biochemistry, Molecular Biology & Biotechnology, University of Colombo, Colombo, Sri Lanka*
[2]*Department of Chemistry, The Open University of Sri Lanka, Nugegoda, Sri Lanka*

**chathukisenarath@gmail.com*

Early-career researchers face limited opportunities to engage in public science communication despite its growing importance. This study presents Martian to Be, a graduate student-led digital initiative demonstrating how young scientists can leverage contemporary platforms to democratize specialized knowledge. Launched in June 2023, the platform addresses making complex space science accessible while countering misinformation in digital spaces. Operating independently across eight platforms (WordPress, YouTube, Facebook, LinkedIn, Instagram, TikTok, Pinterest, X) over 18 months, the initiative applied evidence-based strategies to deliver 43 educational videos covering Mars colonization, astrobiology, space medicine, radiation shielding, and robotics. The researcher-led approach enabled authentic content grounded in active research engagement, with systematic evaluation using platform analytics. Content format experimentation revealed educational videos achieved 15% higher engagement than static posts, while interactive infographics generated 25% more shares. YouTube demonstrated exceptional retention rates (89-99% for core science topics), with astrobiology and Mars exploration achieving highest engagement (18% and 22% respectively). Statistical analysis revealed strong positive correlations between follower growth and link-based content sharing ($r=0.989$, $p<.001$), supporting evidence-based communication approaches. Geographic analysis demonstrated 60% user engagement from South Asian regions (Sri Lanka, India, Pakistan), directly addressing documented gaps in regional access to specialized science education. Non-follower engagement averaged 51.5%, indicating effective content discovery beyond established networks. User feedback showed 78% found content accessible despite technical complexity, with 85% reporting increased interest in space sciences. This study demonstrates that graduate students can effectively establish scalable science communication platforms using freely available digital tools, contributing to public science literacy while developing transferable skills. The methodology provides a replicable framework for young scientists seeking to bridge the research-public divide. Future work will implement A/B testing of content formats, expand to collaborative multi-researcher models, and develop structured metrics for assessing long-term educational impact on diverse audiences.

Keywords: *Digital engagement, graduate research, public outreach, researcher-led initiatives, science communication*

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Applications of artificial intelligence in haemodialysis therapy for end-stage renal disease: A systematic review

D.A. Patabadige[1], P. Rajakaruna[1], N. Jayawardena[1], L. Edirisinghe[1], S. Krishnapradeep[1], U. Jayasinghe[1], H. Usoof[1], R. Abeyskera[1], N. Piyarathne[1]*

[1]*University of Peradeniya, Kandy, Sri Lanka, 20400*

**piyarathnenadisha@dental.pdn.ac.lk*

Haemodialysis (HD) for End-Stage Renal Disease (ESRD) warrants complex clinical management. The advent of artificial intelligence (AI) presents new opportunities to optimize HD therapy; while, evidence on how AI has been applied to assist HD care globally is scarce. This systematic review aimed to summarizes and critically appraise published literature on the use of AI to assist HD in ESRD. The protocol followed PRISMA-2020 guidelines and was registered (CRD42024596375). An electronic literature search was conducted in PubMed, Scopus, Web of Science, and IEEE Xplore databases and a grey literature search via Google Scholar using keywords related to AI and ESRD. Screening, study selection and data extraction were conducted by two independents, blinded, reviewers following calibration. Risk of bias assessment was conducted using a custom 13-item checklist aligned with PROBAST principles. Descriptive analysis and narrative synthesis were conducted. Out of 6,455 initial abstract records screened, n=82 unique records were included. The majority (75.6%) of studies were published from 2018 onwards. The studies demonstrated prediction models focusing on patient mortality and survival, intradialytic complications (e.g., hypotension, vascular access failure, anaemia), and models on dialysis adequacy and parameter optimization (e.g., Kt/V, dry weight, anaemia management). Various ML and DL methods were employed, including (ANNs, SVM, RF, Gradient Boosting, CNN, RNN/LSTM/GRU, Fuzzy Logic, Expert Systems, and RL). While many models reported high predictive performance (e.g., AUCs >0.80), the overall methodological quality was variable, with only 45.1% of studies rated as 'Good' with minimum risk of bias. Methodological limitations such as the lack of external validation, single-center, retrospective data, potential selection biases, suboptimal missing data handling, and concerns regarding unbiased outcome assessment were identified in the studies. To bridge the gap between research innovation and tangible clinical impact, future efforts must prioritize methodologically rigorous, multi-center prospective studies that incorporate independent external validation as a standard.

Keywords: *AI in healthcare, artificial intelligence, end stage renal disease, haemodialysis, systematic review.*

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Marketing campaign optimization using the coordinate exchange algorithm

N.B.M. Prasadini[1*], A.W.L.P. Thilan[1]

[1]*Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka*

**malshaprasadini76@gmail.com*

Optimizing marketing budgets is crucial for maximizing returns in today's highly competitive advertising environment. Inefficient allocation of resources across media platforms often results in suboptimal campaign outcomes. Although multiple linear regression models are commonly used to evaluate the influence of media channels, traditional approaches relying solely on regression coefficients fail to provide the most efficient allocation strategy. To address this limitation, this study proposes a novel optimization framework that integrates the Coordinate Exchange Algorithm with D-optimality criteria to enhance the effectiveness of marketing budget allocation. Historical campaign data were analysed using a multiple linear regression model to examine budget distribution across three key media channels—television, radio, and social media. The Coordinate Exchange Algorithm, an iterative optimization technique, was employed to systematically reallocate the budget across channels, while D-optimality evaluated each allocation by maximizing the information content of the regression model. This combined approach identifies the most informative and performance-enhancing budget configuration. The analysis yielded a highly significant model ($R^2 = 0.999$) with regression coefficients of 3.55, 0.0019, and 0.064 for television, radio, and social media, respectively. Unlike conventional methods that depend on comparing regression coefficients to determine channel influence, our framework quantifies overall campaign efficiency and provides a robust, data-driven foundation for decision-making. Findings indicate that television advertising exerts the strongest influence on sales, while the optimized allocations across all media channels lead to improved campaign performance. The proposed method offers a systematic, evidence-based approach for marketers to allocate budgets strategically, enhancing both campaign effectiveness and return on investment.

Keywords: *Budget allocation, D-optimality, media planning, sales performance*

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A fractal analysis of the dependence of the three-body problem on initial conditions

H. Liyanage[1], N.D. Subasinghe[1*]

[1]*National Institute of Fundamental Studies, Hanthana Road, Kandy, Sri Lanka*

**deepal.su@nifs.ac.lk*

The Newtonian three-body problem, which evaded complete solutions for centuries has in the recent decades been investigated in light of fractals. Fractal patterns have been shown to arise in many contexts of the problem. The present research analyses the behaviour of a planar three-body system in relation to its initial conditions. While the initial positions of two of the bodies are kept constant, that of the 3rd is varied on the coordinate plane. The initial position of the third body leads the system to three possible types of paths: collision, escape, and bounded. Out of these, the basins of attraction of the collision orbits are plotted. The *Verlet* method of symplectic integration is used on Newton's law of gravitational attraction to calculate the paths of the bodies using *Python* code. The fractals obtained have riddled basins of attraction with ring patterns. Fractals where the initial velocity and the mass of the third body are varied are analysed. It is observed that with the increment of mass of the 3rd body, ring patterns in the basins become enlarged, while the symmetry of the fractal is preserved. With the increment of the initial velocity of the 3rd body, asymmetry in the fractal pattern increases. The systems such as those investigated in the research where the 3rd body is more massive than the other two find their astrophysical significance in systems such as the Pluto-Nix-Hydra system and the D9 binary star system orbiting the supermassive black hole Sagittarius A* at the centre of the Milky Way.

Keywords: *Basins of attraction, riddled basins, ring patterns, symmetry, Verlet integration*

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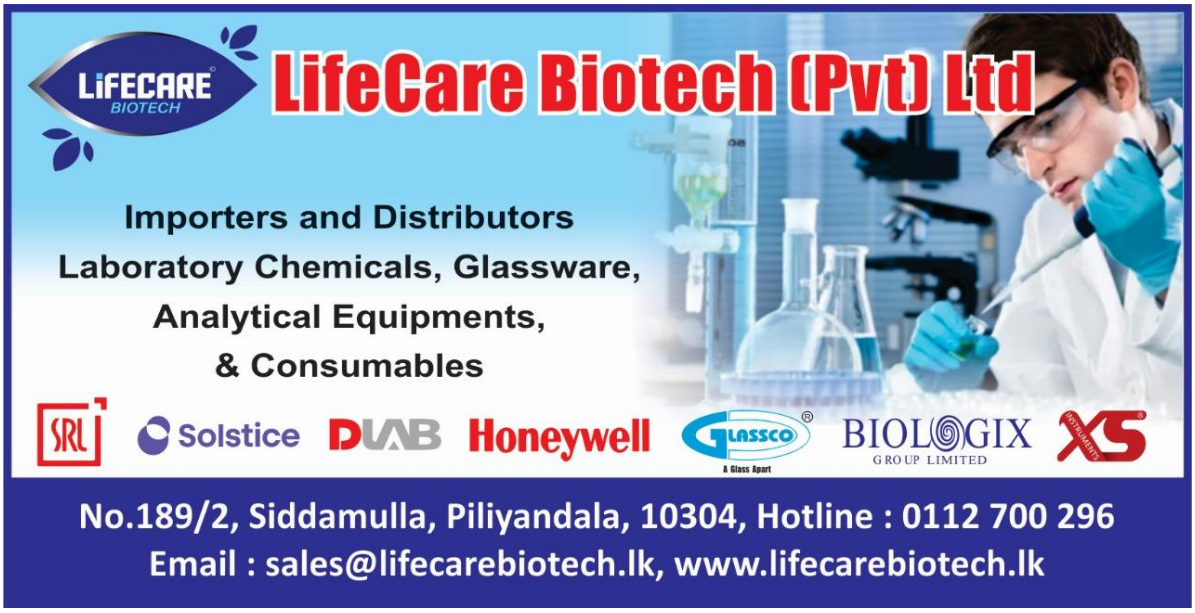

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