UNIVERSITY OF KELANIYA | Faculty of Graduate Studies

iprc 2025

CONFERENCE PROCEEDING

Track - *Science, Technology, Engineering, Mathematics, and Medicine*

25th INTERNATIONAL POSTGRADUATE RESEARCH CONFERENCE (IPRC) 2025

"DIGITAL TRANSFORMATION IN GREEN AND SUSTAINABLE INNOVATION"

25th International Postgraduate Research Conference (IPRC) - 2025

"Digital Transformation in Green and Sustainable Innovation"

Abstracts

Conference Track - Science, Technology, Engineering, Mathematics, and Medicine

13th November 2025

Faculty of Graduate Studies

University of Kelaniya, Sri Lanka

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Message from the Vice-Chancellor

It is with great pleasure that I write this message of felicitation for the 25th Annual International Postgraduate Research Conference (IPRC), organized by the Faculty of Graduate Studies, University of Kelaniya. This is the flagship research conference of our University, a forum for researchers and scholars to share knowledge, information, exchange experiences, to present innovative concepts and research.

Celebrating its Silver Jubilee this year, the IPRC has consistently demonstrated our University's strong commitment to promoting research excellence. This year's theme of Digital Transformation in Green and Sustainable Innovation aims to inspire new perspectives on how digital transformation can drive environmentally responsible and inclusive growth.

As in past years, the conference will be conducted under four tracks:

1. Science, Technology, Engineering, Mathematics, and Medicine
2. Accounting and Business Management
3. Humanities and Social Sciences
4. Multidisciplinary Studies

As the University of Kelaniya expands its offering of postgraduate programs, with particular attention to multi-disciplinary studies and the promotion of interdisciplinary research, we strive to nurture the next generation of scholars who will contribute to the sustainable development of our country. Our vision of digital transformation of our University echoes the national vision of digital transformation of our country's economy. We hope that all those who participate in IPRC 2025 share our desire to embark on this promising and exciting journey, which also brings its own challenges.

I thank the Dean of the Faculty of Graduate Studies, Snr. Prof. Priyani Paranagama, the Deputy Registrar / FGS Mr. Lakmal Wijeratne, the Senior Assistant Bursar / FGS Ms. Sathishka Gonapeenuwala, and the conference Organizing Committee, for all the hard work that they have put into organizing this event. I would also like to thank the researchers, reviewers, editors, and other academics who contributed in numerous ways to ensure the success of this conference.

Senior Prof. Nilanthi Renuka de Silva
Vice-Chancellor
University of Kelaniya

Message from the Dean of the Faculty of Graduate Studies

It is with great pleasure that I welcome you to the International Postgraduate Research Conference (IPRC) 2025, hosted by the Faculty of Graduate Studies at the University of Kelaniya. This year's conference is particularly special as we commemorate the silver jubilee, marking a quarter-century of commitment to advanced research, academic excellence, and knowledge dissemination.

The theme of IPRC 2025, "Digital Transformation in Green and Sustainable Innovation," reflects our dedication to addressing contemporary global challenges through cutting-edge research and interdisciplinary collaboration. The conference provides a distinguished platform for postgraduate researchers, scholars, and practitioners from around the world to present their work, exchange ideas, and foster innovation that contributes meaningfully to sustainable development and technological advancement.

As the oldest and most pioneering research conference at the University of Kelaniya, IPRC has successfully held 25 consecutive annual conferences, and continues to serve as a flagship event in our academic calendar. This milestone is a testament to the unwavering commitment of the Faculty of Graduate Studies to encourage advanced research, support academic inquiry, and cultivate a vibrant intellectual community.

IPRC 2025 symbolizes the vision and mission of the Faculty of Graduate Studies, where knowledge is recognized as a powerful tool to affect change. Through promoting analytical skills, openness to new ideas, and research excellence, FGS empowers its graduates to make a meaningful impact in society. The conference is an opportunity to showcase innovative postgraduate research, engage in thoughtful discussions, and build collaborations that will shape the future of green and sustainable innovation.

I extend my sincere gratitude to all participants, keynote speaker, plenary speakers, presenters, and organizers for contributing to this landmark event. Let us come together to make IPRC 2025 a celebration of academic excellence, global collaboration, and transformative research.

Senior Prof. P.A. Paranagama
Dean
Faculty of Graduate Studies
University of Kelaniya

Message from the Chairman of the Research Council

It is with great pleasure I write this message to the International Postgraduate Research Conference (IPRC) 2025 organized by the Faculty of Graduate Studies, University of Kelaniya. Since the first conference in 2000, the Annual Research Symposium of the Faculty of Graduate Studies has been an important event of the University Research Callender. The IPRC 2025 marks a significant milestone being the silver jubilee edition of this flagship postgraduate research event.

IPRC 2025 is truly a multidisciplinary Research symposium with dedicated tracks for Science, Technology, Engineering, Mathematics, and Medicine; Accounting and Business Management; Humanities and Social Sciences; and Multidisciplinary Studies. It provides an international platform for researchers to share their findings, exchange ideas, and explore innovative solutions for sustainable development.

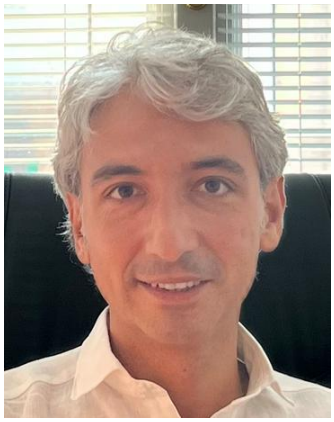
This year's theme, 'Digital Transformation in Green and Sustainable Innovation' well reflects how research can be transformative and help to foster a sustainable ecosystem. I am confident that the Conference will generate new ideas, methodologies, and collaborations to uplift the research environment, culture, and output of the University.

I wish all the very best for the Faculty of Graduate Studies and IPRC 2025.

Professor Sachith Mettananda
Chairperson
Research Council
University of Kelaniya

Profile of the Keynote Speaker – Prof. Piergiuseppe Morone

Full professor of Economic Policy, Unitelma Sapienza – University of Rome, Department of Law and Economics, Roma, Italy.
Ph.D., Science and Technology Policy – University of Sussex, UK, M.A., Development Economics – University of Sussex, B.A. (cum laude), Economics – University of Bari, Italy.



Piergiuseppe Morone is Full Professor of Economic Policy at Unitelma Sapienza with a strong interest in green innovation and sustainable circular bioeconomy pushing his research at the interface between innovation economics and sustainability transitions, an area of enquiry that has attracted growing attention over the last decade. His work regularly appears in prestigious innovation and environmental economics journals. In 2023 published with Cambridge University Press a textbook on The Circular Bioeconomy - Theories and Tools for Economists and Sustainability Scientists.

He is the coordinator of the Bioeconomy in Transition Research Group (BiT-RG) and the director of the School of Sustainability Studies and Circular Economy (SUSTAIN). Moreover, he is/was involved in several European projects (including: H2020, BBI-JU, Life, Erasmus+, COST, Horizon Europe and CBE-JU) acting as scientific coordinator, vice-chair and WP Leader. He was Economic advisor to the Italian Minister of the Environment, Land and Sea Protection, till February 2021. Piergiuseppe is Editor in Chief of Societal Impacts (ELSEVIER) and Associate Editor of several other prestigious journals.

Since April 2022 Piergiuseppe is the vice-chair of the Circular Bio-based Europe Joint Undertaking (CBE JU) Scientific Committee.

Plenary Speaker - Prof. Janaka Yasantha Ruwanpura

Schulich School of Engineering, Department of Civil Engineering, University of Calgary, Canada
Ph.D., Construction Engineering and Management – University of Alberta, Canada (2001)
M.Sc., Construction Management – Arizona State University, USA (1997)
B.Sc. (Hons), Quantity Surveying – University of Moratuwa, Sri Lanka (1992)Oregon)

Professor Janaka Yasantha Ruwanpura is a highly respected academic, researcher, and global leader in construction engineering, project management, and international higher education. He is currently a Professor in the Department of Civil Engineering at the Schulich School of Engineering, University of Calgary. He recently concluded over 11 years of service as the Vice-Provost and Associate Vice-President Research (International), during which he significantly advanced the university's international engagement and reputation.

During his tenure as Vice-Provost International, Professor Ruwanpura played a pivotal role in shaping and implementing the University of Calgary's international strategy. His leadership led to the creation of several collaborative degree programs, research partnerships in countries like China and Mexico, and the acquisition of more than $57 million in research and infrastructure funding. He also secured over $25 million in international development grants and more than $5 million for student research internships through MITACS. Notably, he became the first Canadian and non-American to be elected Executive Chair (2019–2021) of the Commission of International Initiatives of the Association of Public and Land-Grant Universities (APLU). Professor Ruwanpura's work has earned him numerous prestigious accolades, including the Top 25 Canadian Immigrant Award (2022) and fellowships with the Canadian Academy of Engineering (FCAE), the Engineering Institute of Canada (FEIC), the Canadian Society for Civil Engineering (FCSCE), and the National Academy of Construction, USA (NAC). In 2022, he was also recognized as a Gold Seal Certified Professional by the Canadian Construction Association.

Abstract of the Plenary Session One: Igniting Research Excellence: Building the Next Generation University for Global Impact

This plenary will present an evidence-based eleven-point framework for advancing institutional research excellence, drawing on global best practices and implementation experience from leading universities. The framework emphasizes transdisciplinary research clusters, targeted funding strategies, publication culture, international collaborations, and industry-engaged innovation. It also highlights internal enablers such as performance-linked incentives, structured research support, and the role of postdoctoral and community engagement. Using this framework, the presentation proposes a tailored roadmap for developing a comprehensive Research Strategy for the University of Kelaniya. Key components include aligning research with national and global priorities, building flagship institutes, and strengthening partnerships for co-funded, high-impact research. The session will demonstrate how strategic planning and structured implementation can transform research ecosystems, improve institutional rankings, and position universities as regional leaders in innovation, knowledge creation, and sustainable development.

Plenary Speaker - Prof. Channa De Silva

Professor of Chemistry, Head of the Department, Department of Chemistry & Physics, Western Carolina University, USA

Ph.D., University of Arizona, Chemistry, B.S., University of Kelaniya, Sri Lanka, Chemistry

Dr. Channa De Silva is a Professor and Department Head of Chemistry & Physics at Western Carolina University, USA. He completed his B.S. degree in Chemistry with First-Class Honors at the University of Kelaniya, Sri Lanka, in 2000 and earned his Ph.D. in Chemistry with a GPA of 4.0 from the University of Arizona, USA, in 2007. From 2008 to 2010, he worked as a Research Associate at the Pacific Northwest National Laboratory, in Materials Science and Engineering at the University of Arizona, and the Bio5 Institute at the University of Arizona, USA. His research focuses on developing metal-based nanomaterials for biotechnological applications and conducting computational studies of materials containing lanthanide and actinide metals.

Dr. De Silva has received numerous teaching and research awards, including the University of North Carolina Board of Governors Award for Excellence in Teaching, USA (2025), the Brinson Honors College's Faculty and Staff Excellence Award, Western Carolina University (2025), the Chancellor's Distinguished Teaching Award (2025), Winner, FACULTY 3 Minute Research Talk (3MR), Western Carolina University, USA (2025), Teaching Award from the College of Arts & Sciences at Western Carolina University (2022), Visiting Faculty Program Scholar from the U.S. Department of Energy (DOE) (2021), SoCon Faculty Member of the Year Award (2019), and Innovative Scholarship Award (2017).

In his free time, he enjoys playing music, including Sri Lankan music, northern Indian music, and an American folk genre called Appalachian music.

Abstract of the Plenary Session Two: Artificial Intelligence in Chemistry Research: Transforming Discovery, Design, and Education

Artificial Intelligence (AI) is rapidly reshaping the landscape of chemical research and education, offering transformative capabilities across molecular design, reaction prediction, process optimization, and teaching. Recent advancements highlight AI's growing role in both undergraduate and graduate-level chemistry, with applications spanning drug discovery, materials science, and sustainable chemical engineering. AI-driven platforms such as ChemCopilot and IBM RXN are streamlining retrosynthesis planning, reaction yield prediction, and real-time process monitoring. Large Language Models (LLMs), including finetuned systems like GVIM, are being integrated into intelligent research assistants capable of molecular visualization, SMILES string processing, and literature retrieval.

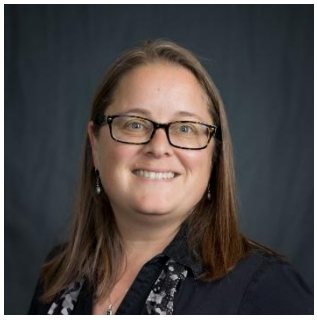
These tools not only enhance research productivity but also democratize access to advanced computational methods. Educationally, AI's integration into chemistry curricula is gaining momentum. Workshops and teacher training programs are fostering Technological Content Knowledge (TCK), preparing educators to bridge the gap between scientific innovation and classroom instruction. The 2025 Nobel Prize in Chemistry, awarded for AlphaFold's protein

structure prediction, underscores AI's interdisciplinary impact and its relevance to future career pathways. Despite its promise, challenges remain in data quality, model interpretability, and ethical deployment. Addressing these issues is essential to ensure scientifically sound and socially beneficial outcomes. This abstract invite discussion on the strategic incorporation of AI into chemistry research and education, emphasizing its potential to accelerate discovery, enhance pedagogy, and prepare students for AI-driven scientific careers.

My own experiences in digital transformation initiatives have underscored the importance of combining technological, social, and economic insights. Gender equality is a crucial focus, especially regarding workforce participation. Through initiatives like 'She Returns,' which supports women re-entering the workforce after maternity leave, we see how multidisciplinary research can solve real-world challenges by bridging gaps in productivity and equality. Academia plays a pivotal role in encouraging cross-disciplinary innovation. However, achieving this requires shifting from specialization to integration, breaking institutional barriers, and promoting collaboration. It is only through collective effort where technologists, economists, sociologists, and policymakers join forces that we can shape a prosperous future. In conclusion, Sri Lanka's path forward embraces innovation and research that transcends boundaries. Together, we can build a resilient economy driven by inclusive growth, ensuring that research not only advances knowledge but also transforms lives and creates lasting societal impact.

Plenary Speaker - Prof. Jane E. Stewart

Associate Professor of Plant Pathology, Department of Agricultural Biology, College of Agricultural Sciences, Colorado State University, USA
Ph.D. (Washington State University), M.S. (University of Vermont), B.S. (University of Oregon)



Dr. Jane E. Stewart is an Associate Professor of Plant Pathology in the Department of Agricultural Biology at Colorado State University in Fort Collins, Colorado, USA. Her research focuses on forest, shade, and fruit trees, addressing critical issues in tree health through the lens of plant pathology. Dr. Stewart brings extensive expertise in fungal biology, population genetics and genomics, molecular diagnostics, and the management of plant pathogens particularly invasive and emerging pathogens affecting trees.

Over the course of her career, Dr. Stewart has published more than 100 scholarly manuscripts spanning various forest and tree crop pathosystems. Her research emphasizes the speciation of tree pathogens and explores host-pathogen interactions at multiple levels, from the microbiome to the molecular scale. She is also actively engaged in developing practical management strategies to combat tree diseases and enhance sustainable forestry and agriculture.

In addition to her research, Dr. Stewart teaches undergraduate and graduate courses at Colorado State University. Her undergraduate course, Tree Health and Management, covers a wide array of tree diseases and insect pests along with their management practices. She also teaches a graduate-level course on Fungal Biology and Genetics, sharing her deep knowledge and research experience with the next generation of plant pathologists.

Dr. Stewart's research program has a global focus, aiming to improve understanding of the biology, ecology, genetics, and management of emerging tree pathogenic fungi. She currently serves as Editor-in-Chief of the internationally recognized journal Forest Pathology, reflecting her leadership and influence in the field.

Abstract of the Plenary Session Three: Characterizing Patterns Associated with Airborne Microbial Communities in Forest and Grassland Ecosystems

Understanding how and what types of microorganisms move through the air is important for early warning detection systems for human and ecosystem health. The atmosphere harbors a diverse and dynamic reservoir of microorganisms, yet their distribution, especially for fungi, in the atmosphere and response to environmental variation remains a subject of ongoing investigation. In this study, we compared airborne bacterial and fungal communities in subalpine forest and steppe grassland sites, over diel, vertical, and seasonal gradients. Air samples were collected at three heights over four months at the subalpine forest with concurrent sampling in the steppe grassland during two of those months. We observed that fungal communities had greater site-specific variability and sensitivity to environmental factors than bacterial communities. This was most apparent in the subalpine forest, where vertical stratification and

diel cycles significantly structured microbial diversity. In comparison, bacterial communities were temporally dynamic but showed weaker responses to local environmental conditions and minimal site-level differences. This may indicate broader dispersal and a ubiquitous set of bacterial taxa. Environmental drivers such as atmospheric moisture and air pressure influenced microbial beta-diversity in the subalpine forest, while air temperature and wind speed impacted diversity in the steppe grassland, again highlighting ecosystem-specific responses. Despite compositional differences, a group of shared bacterial and fungal taxa was consistently detected across sites. Most of these shared taxa were detected at greater heights in the subalpine forest. This, along with wind patterns moving eastward from the subalpine forest towards the steppe grassland, indicates potential atmospheric transport between sites, with taxa dispersal being filtered by height. These results underscore the role of ecosystem structure, meteorological conditions, and air mass movement in shaping the aero biome. Our data suggest that airborne microbial communities are shaped by both local emission and long-range atmospheric transport processes.

Plenary Speaker - Dr. Rajesh Shah

Professor in Sitar, Department of Instrument, Faculty of Performing Arts, Banaras Hindu University, India

Ph.D., BHU, Varanasi, India, M.Mus., BHU, Varanasi, India, B.Com., Gorakhpur University, Gorakhpur, India

Prof. Rajesh Shah is a distinguished artist and academic in the field of Indian Classical Instrumental Music, specializing in the sitar. Born on June 15, 1966, into a culturally rich Gujarati family, he inherited his passion for classical music from his father, Sri Narottam Das Shah. Over the course of his illustrious career, Dr. Shah has established himself as a leading figure in sitar performance, pedagogy, and music composition, contributing significantly to the propagation and preservation of India's classical music heritage.

Currently serving as a Professor in the Department of Instrumental Music at the Faculty of Performing Arts, Banaras Hindu University (BHU), Prof. Shah has also held key academic positions, including Dean of the Faculty and Head of the Department. A Grade 'A' artist of All India Radio and Doordarshan, he is renowned for his solo sitar recitals, jugalbandis (duets), and orchestral compositions, both in India and abroad.

Prof. Shah's musical foundation was shaped by the rigorous training he received under the guidance of Late Sri Govind Raoji Nayak and the late Dr. Ramdas Chakravarti of BHU, followed by advanced tutelage from Pt. Amarnath Mishra of the Banaras Gharana. Deeply rooted in the Saini Gharana tradition, his sitar style is noted for its clarity, creativity, and expressive depth.

An active performer, Prof. Shah has presented concerts and conducted workshops across Europe, Central Asia, the Middle East, and South Asia, including notable appearances in Germany, Austria, Azerbaijan, Kazakhstan, Mauritius, UAE, and Nepal. In addition to his international reach, he is a respected educator who has mentored over 16 Ph.D. scholars and numerous postgraduate students. Many of his disciples now serve as faculty members in reputed universities and cultural institutions worldwide.

His commitment to inclusive education is exemplified by his longstanding work with visually impaired students, whom he has trained in the intricate art of sitar performance. He has also composed and directed several orchestral works specifically for visually impaired musicians, earning recognition at international platforms such as Vienna and across Indian cities.

Prof. Shah has authored the book "Sitar Vigyan: Prayog Evam Shastra" and contributed extensively to academic journals and conference proceedings at both national and international levels. His research interests span from traditional raga interpretation to music therapy, music education, and comparative musicology.

Beyond teaching and performance, he has served on various academic and administrative bodies, including as a member of Boards of Studies and selection committees in universities such as Visva

Bharati University, Dr. Ram Manohar Lohia Awadh University, and M.S. University, Baroda. He has also acted as a convener and resource person in numerous interdisciplinary workshops and seminars focused on Indian classical music.

Through his artistic excellence, academic contributions, and inclusive teaching philosophy, Prof. Rajesh Shah continues to be a guiding force in the world of Indian classical instrumental music.

Abstract of the Plenary Session Four: Rendition of Similar Ragas in North Indian Classical Music

North Indian Classical Music, or Hindustani music, is built upon the intricate and deeply aesthetic concept of the raga a melodic framework for improvisation and composition. Each raga is defined by a unique set of notes (swaras), characteristic phrases (pakad), and mood (rasa), which together create a distinct identity. However, within this rich system exists a fascinating phenomenon the presence of similar ragas, whose tonal structures and emotional colors overlap, yet whose renditions must remain distinct through nuanced expression.

Many ragas share the same or nearly identical scales but differ in their treatment, ornamentation, and emphasized notes. For instance, Raga Desh and Raga Khamaj both use the komal nishad (flat seventh) and shuddha nishad (natural seventh), yet their melodic contours and emotional intent diverge significantly. Desh evokes the freshness of monsoon and a feeling of longing, while Khamaj carries a romantic and serene flavor. Similarly, Raga Bhupali and Raga Deshkar share the pentatonic scale (using Sa Re Ga Pa Dha), but the former flows with a lyrical, devotional sweetness, while the latter projects brightness and vigor through sharper tonal emphasis and a more forceful rendition.

The distinction among similar ragas primarily depends on intonation, movement, and emphasis. The vadi (most prominent note) and samvadi (second most prominent note) play a crucial role in shaping the identity of a raga. Ornamentations such as meend (glide), kan swar (grace note), and gamak (oscillation) further add character. The choice of tempo (laya), rhythmic cycle (tala), and mood (bhava) also influences how the listener perceives one raga from another, even when the note structures are similar.

Experienced performers internalize these subtleties through years of training under the guru-shishya parampara. A successful rendition of similar ragas demands deep understanding and restraint knowing precisely how to explore the raga's potential without encroaching upon the domain of another. The artist's improvisation (vistar, alap, taan) must unfold within the grammar of the chosen raga, revealing its individuality through creativity grounded in discipline.

Thus, the rendition of similar ragas in North Indian classical music exemplifies the art's philosophical depth the coexistence of similarity and uniqueness, structure and freedom. It is this delicate balance that sustains the immense beauty and complexity of the Hindustani raga tradition, allowing it to evolve continuously while preserving its timeless essence.

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Cuffless hypertension prediction using pulse waveform analysis and deep learning

P.A.D.H.J. Gunathilaka[1,2*], R.A.R.S. Rajapaksha[3], B.M.T. Kumarika[3], K.M.D.C. Jayathilaka[2], D.P. Perera[4], M.H.M.U.P. Herath[5], J.A. Liyanage[6] and S.R.D. Kalingamudali[2]

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Hypertension remains one of the leading contributors to cardiovascular morbidity and mortality worldwide, often progressing silently until complications arise. Traditional cuff-based blood pressure monitoring is intermittent, operator-dependent, temperature sensitive, uncomfortable, and raises environmental concerns due to non-biodegradable waste. This study proposes a novel, non-invasive approach for hypertension detection using photoplethysmography (PPG) waveform images that were analyzed through deep learning models, aiming to facilitate more comfortable screening solutions. Participants included 200 individuals diagnosed with hypertension and 200 healthy individuals over 18 years old as the control group, and consisted of age and gender-matched individuals. PPG signals were recorded from the left index finger using a multiparameter patient monitor. From each recording, five representative single-cycle pulse wave images were cropped, resized, and normalized, resulting in a balanced dataset of 2000 pulse wave images. These were randomly partitioned into training (70%), validation (15%), and testing (15%) sets without subject overlap to ensure unbiased evaluation. Two deep learning models, a custom convolutional neural network (CNN) developed through iterative architectural refinement and hyperparameter tuning, and a pre-trained VGG16 model fine-tuned to evaluate the effectiveness of transfer learning, were developed and assessed for classifying pulse wave images. The CNN outperformed VGG16 with a training accuracy of 87.93% and testing accuracy of 87.33%, along with balanced precision (87.67%), recall (87.33%), and F1-score (87.30%). VGG16 achieved comparable results but exhibited slightly reduced generalization capability. This study demonstrates the potential of image-based PPG analysis for hypertension screening using CNN models, which effectively detect waveform changes associated with hypertensive status. It supports the development of cuffless, real-time monitoring systems that offer improved comfort and environmental sustainability. Although limited by a small, homogeneous dataset and manual waveform selection, future advancements and multimodal integration could enhance clinical applicability and transform hypertension detection.

Keywords: Hypertension, Photoplethysmography, Pulse, Screening

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IPRC/25/196 Science, Technology, Engineering, Mathematics, and Medicine

Investigation of N520 dye sensitization in dye-sensitized solar cells using SnO_2/ZnO composite

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Dye-sensitized solar cells (DSSCs) are photovoltaic devices that convert sunlight into electricity. DSSCs rely on photochemical process unlike conventional silicon based solar cells, which makes them cost effective and capable of working under low-light conditions. A photosensitized dye is used to capture sunlight and initiate electron transfer in dye-sensitized solar cells. This study addresses the lack of research on N520 dye in DSSCs by evaluating its performance with a SnO_2/ZnO composite photo anode. While SnO_2/ZnO has been explored with other dyes, its application with N520 remains understudied. The device manufacturing process involves applying semiconductor oxide layers to FTO substrates by the spray-coating method. Then the cells were sintered at 500 °C for 30 minutes. The sintered cells were dipped in N520 dye solution for 24 hours, and the solar cells were assembled with a platinum counter electrode and an iodide/triiodide liquid electrolyte. The performance evaluation was done using *J-V* measurements using a solar simulator. Among the three photoanode materials; SnO_2, ZnO and SnO_2/ZnO composite, the SnO_2/ZnO composite yielded the highest performance with a power conversion efficiency of 1.88%, a short-circuit current density (J_{sc}) of 4.53 mA/cm^2, open circuit voltage (V_{oc}) of 580.58 mV and a fill factor (FF) of 0.71. Improved performance in the system is caused by more efficient electron transfer and less recombination at the heterojunction interface. UV-Vis spectroscopy confirmed strong absorption at 528 nm due to the conjugated system of the dye, while Raman spectra verified the presence of characteristic vibrational peaks, indicating successful dye adsorption. Even though this dye has limited previous studies, these findings suggest its potential for further development.

Keywords: Dye-sensitized solar cells, Energy conversion efficiency, SnO_2/ZnO composite, N520 dye

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IPRC/25/198 Science, Technology, Engineering, Mathematics, and Medicine

Comparative analysis of proximate composition in bêche-de-mer derived from wild and farmed sandfish (Holothuria scabra)

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Sandfish (*Holothuria scabra*) is a high-value sea cucumber species harvested from tropical coastal waters. It is typically processed into *bêche-de-mer*, a luxury seafood commodity popular in East Asian markets. Overexploitation has led to the depletion of natural sandfish stocks, giving rise to sandfish aquaculture, which is now an emerging industry in many countries. However, *bêche-de-mer* produced from wild sandfish remains higher demand, as its quality is considered to be of superior compared to its farmed counterpart. Therefore, the present study aimed to assess the proximate composition of *bêche-de-mer* derived from both wild and farmed sandfish. *Bêche-de-mer* samples of similar weights (13.2 ± 2.2 g) from wild and farmed sandfish (n = 10 each) were obtained from a sea cucumber processing facility in Jaffna in 2023. The proximate composition, moisture, crude protein, crude fat, and crude ash content, was analyzed using standard test procedures. The average moisture content was 8.56 ± 0.34% in wild samples and 8.47 ± 0.12% in farmed samples. Crude ash content (dry matter basis) was 31.27 ± 1.75% and 29.84 ± 0.65% in wild and farmed *bêche-de-mer*, respectively. Crude protein content was higher in wild samples (62.02 ± 1.07%) compared to farmed ones (54.88 ± 2.25%, $p<0.05$), while crude fat content was slightly lower in wild samples (1.17 ± 0.04%) than in farmed ones (1.25 ± 0.06%). The lower protein content observed in *bêche-de-mer* derived from farmed sandfish may be attributed to restricted movement and increased competition for food within grow-out systems. Enhancing food availability in these facilities could potentially improve protein content in farmed sandfish.

Keywords: *Bêche-de-mer*, proximate composition, sandfish

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IPRC/25/202 Science, Technology, Engineering, Mathematics, and Medicine

Effect of particle size on optoelectronic properties of chemical bath deposited cadmium sulfide thin films

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Cadmium sulfide (CdS), is a widely explored II–VI semiconductor in the field of photovoltaic (PV) technologies due to its promising optoelectronic characteristics. This study reports the effect of CdS particle size on its optoelectronic properties, such as flat band potential (V_{FB}), open-circuit voltage (V_{OC}), short-circuit current (J_{SC}), and optical band gap (E_g). The CdS films were grown on fluorine-doped tin oxide (FTO) substrates using a bath composed of $CdSO_4$ (0.1 mol.dm^{-3}) and $CS(NH_2)_2$ (0.2 mol.dm^{-3}), with varying concentrations of ascorbic acid ($C_6H_8O_6$, AA) as a mild reducing agent (0 to 0.0001 mol.dm^{-3}), at 80 °C and pH 11 for one hour before annealing at 300 °C in air. The structural analysis via X-ray diffraction (XRD) confirmed hexagonal crystallinity across all samples. Scanning electron microscopy (SEM) revealed significant morphological differences in pristine CdS and AA-treated samples, where AA-treated films displayed uniformly distributed nanoparticles. The particle size was found to decrease with AA concentration and the lowest diameter of ~50 nm was observed at 0.001 mol.dm^{-3} AA, whereas untreated films showed larger aggregates (~150 nm). Notably, the optical band gap (E_g) exhibited a tunable range from 2.27 to 2.40 eV with AA concentration. The CdS films grown with 0.001 mol.dm^{-3} AA demonstrated a 130.46% increase in J_{SC} and a 147.87% enhancement in V_{OC}×J_{SC} compared to the untreated CdS film. Furthermore, Mott-Schottky analysis confirmed n-type behavior in all films, with the V_{FB} shifting from -436 mV (untreated) to -613 mV for the AA-treated (0.001 mol·dm^{-3}) sample, confirming improved electronic properties. In conclusion, these nanoscale features contributed to an increased effective surface area, thereby improving light absorption and charge transport. These findings underscore the efficacy of ascorbic acid as a CdS particle size tunable agent for the development of high-efficiency CdS thin films for PV applications.

Keywords: Ascorbic acid, CBD, CdS, Flat band, Thin films

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IPRC/25/203 Science, Technology, Engineering, Mathematics, and Medicine

Microbial synergy in hydrocarbon breakdown: *Bacillus* sp. and *Brucella* sp. driving n-octacosane degradation

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Petroleum-contaminated sites are often enriched with indigenous hydrocarbon-degrading microorganisms, capable of integrating hydrocarbons into actively cycling carbon pools. However, single microbial species may not be sufficient in this process due to the complex nature of petroleum hydrocarbons. Instead, a versatile microbial consortium offers a more effective approach for enhanced bioremediation. In our preliminary study, bacteria in the crude oil-contaminated soil in *Sapugaskanda*, Sri Lanka, were isolated, with particular emphasis on a specialized consortium, which we referred to as 'BBPS,' comprising *Bacillus* sp., *Brucella* sp., individual strains of *Pseudomonas aeruginosa*, and *Stenotrophomonas maltophilia*. The single and the mixed cultures were inoculated separately into Basal Salt Media (BSM) supplemented with 0.1% (v/v) or (w/v) n-octacosane (C28:0), n-docosane (C22:0) and n-hexadecane (C16:0) (separately) as the sole carbon source and incubated on an orbital shaker (28 ºC, 100 rpm, 5 days). Microbial cells were harvested at 12-hour intervals by centrifugation, and the cell pellets were dissolved in 10 ml of BSM, followed by the optical density measurement at 600 nm. The growth kinetics were analyzed using OD_{600} vs time, the maximum OD_{600} (OD_{600max}) values were compared among groups using Kruskal-Wallis test to evaluate the statistically significant treatment. Results revealed that the *Bacillus-Brucella* partnership exhibited significantly superior (n=4, p=0.0006) n-octacosane degradation capabilities (1.26 ± 0.017) compared to the other combinations. Further, the findings affirm that the combination of *P. aeruginosa* and *S. maltophilia* showed significant degradation of n-docosane (0.74 ± 0.057) over *Bacillus-Brucella* partnership (p=0.0004), indicating its ability to either utilize shorter intermediate hydrocarbons present in the medium and/or function as a facilitator for the hydrocarbon degradation. The extended study of this consortium will establish a complex network of metabolite exchange and communication, potentially leading to more efficient and robust applications in bioremediation and microbial-enhanced oil recovery (MEOR) in the future.

Keywords: *Bacillus* sp., *Brucella* sp., microbial-enhanced oil recovery, microbial n-alkane degradation, n-octacosane

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IPRC/25/211 Science, Technology, Engineering, Mathematics, and Medicine

Growth of Cu_2O films in acetate and hydrogen peroxide baths: A comparative study of photoresponses in a photoelectrochemical cell

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Comparison of the photoactive performance of Cu_2O films grown in acetate and hydrogen peroxide baths were studied in a photoelectrochemical cell (PEC) containing 0.1 M sodium acetate aqueous solution. Cu_2O thin films were potentiostatically electrodeposited at -200 mV vs Ag/AgCl for 30 min on Ti substrates using a three-electrode system having an acetate bath (0.1M sodium acetate and 0.01M cupric acetate). In the hydrogen peroxide bath, films were electrodeposited on Ti/Cu_2O electrodes at -100 mV vs Ag/AgCl reference electrode for 30 min in a three-electrode system containing 0.1 M Cupric sulphate ($CuSO_4$), 0.3 M Hydrogen peroxide (H_2O_2), 0.05 M Sodium nitrate ($NaNO_3$) and NaOH. The bath pH was adjusted to 4 with NaOH. The Cu_2O seed layer was prepared in the acetate bath for a duration of 2 min of deposition. X-ray diffraction (XRD), scanning electron microscopy (SEM), Current–Voltage (I-V) and Capacitance-Voltage (C-V) measurements in the PEC were used to characterize the samples. XRD measurements revealed that samples prepared in the acetate bath had only Cu_2O while samples prepared in the hydrogen peroxide bath consisted of Cu in addition to Cu_2O. SEMs showed that flower-like morphology of Cu_2O for the films prepared in the hydrogen peroxide bath. The photoresponse of the samples prepared in the acetate bath changed to p-type when annealed at 300 ^oC. However, samples produced in the hydrogen peroxide bath exhibited only p-type photoresponse in the PEC. Thus, the study reveals that the net defect concentration in Cu_2O is responsible for the n-type or p-type behavior of the films and it is governed by the nature of the deposition bath. In conclusion, samples prepared in the acetate bath produce n-type behavior, while samples prepared in the hydrogen peroxide bath produce p-type behavior in a PEC.

Keywords: Annealing, Conductivity type, Flower-like morphology, Photoresponse

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IPRC/25/213 Science, Technology, Engineering, Mathematics, and Medicine

Evaluation of toxicity of a crude extract combination of *Cinnamomum verum, Curcuma longa,* and *Ocimum tenuiflorum* using the brine shrimp lethality assay

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Cinnamomum verum, Curcuma longa, and *Ocimum tenuiflorum* are used in various ayurvedic preparations in Sri Lanka. Even though the medicinal value of the plant has been extensively studied, the toxicity of the plant remains unknown. Therefore, it is vital to identify the toxicity for dosage determination of formulations. This study identifies the minimum toxic concentration of the crude extract of a combination of *Cinnamomum verum, Curcuma longa,* and *Ocimum tenuiflorum* plants, using the brine shrimp (*Artemia salina*) lethality assay. Authenticated plant material was air-dried, ground, and macerated (1:5) in ethanol and distilled water to extract the compounds. A mixture of 1 g of plant powder was dissolved in 10 mL of distilled water, and a two-fold dilution series of 15 concentrations was tested, ranging from 5×10^{-2} g/mL to 3.013×10^{-6} g/mL. Toxicity was assessed at 24 hours, with ten nauplii exposed to each concentration. Mortality rates were observed, and the LC_{50} was calculated using GraphPad Prism 10.4.1 software. Results were compared with Meyer's and Clarkson's toxicity scales (LC_{50} < 1000 µg/mL = toxic, LC_{50} > 1000 µg/mL = non-toxic). The study was duplicated. Statistical validation was performed using GraphPad Prism 10.4.1 software. The highest mortality percentage (100%) was observed for 5×10^{-2} g/mL – 62.5×10^{-4} g/mL, resulting LC_{50} of 0.00335 g/mL (3354µg/mL) for the plant mixture. The brine shrimp lethality assay yielded an LC_{50} value of 0.00335 g/mL (3354 µg/mL), placing the plant combination within the moderate toxicity range according to Meyer's and Clarkson's scale. Although the extract demonstrates potential biological significance, the indication of moderate toxicity necessitates a comprehensive safety evaluation. Future investigations should focus on establishing safe concentration levels, optimizing the ratio of plant combinations, and eliminating toxic constituents to improve the suitability of the formulation for therapeutic applications.

Keywords: Brine shrimp lethality assay, Cinnamomum verum, Curcuma longa, Ocimum tenuiflorum, Toxicity

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IPRC/25/215 Science, Technology, Engineering, Mathematics, and Medicine

Investigation of toxic metal contamination in upcountry agricultural soil, vegetables, and water: A study from Nuwara Eliya District, Sri Lanka

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The issue of heavy metal pollution in agricultural settings poses a severe threat to food safety and public health. This research examines the concentration of lead (Pb), cadmium (Cd), chromium (Cr), arsenic (As), and nickel (Ni) in agricultural soil and irrigation water along with the crops commonly consume in Shanthipura division, Nuwara Eliya District in Sri Lanka during the dry season. Thirty samples each of soil, water, and leafy vegetables (spinach, cabbage) were collected from major cultivation zones. Soil and vegetable samples were digested using microwave digestion, and the concentrations of toxic metals were analyzed using Inductively Coupled Plasma Mass Spectrometer (ICP-MS). All statistical analyses were performed using SPSS version 26.0 (IBM, USA). The results compared with the WHO permissible limits. In soil samples, mean concentrations are As = 3.36 (± 1.40) mg/kg, Cd = 0.14 (± 0.12) mg/kg, Cr = 63.22 (± 34.13) mg/kg, Ni = 10.94 (± 5.58) mg/kg, and Pb = 39.14 (± 41.11) mg/kg. Water samples, mean values are: As = 0.58 (± 0.27) µg/L, Cd = 0.06 (± 0.0)5 µg/L, Cr = 0.67 (± 0.87) µg/L, Ni = 9.25 (± 18.86) µg/L, and Pb has not detected. As concentration in soil samples surpassed WHO guidelines. All values of water samples were within safe thresholds. Leafy Vegetable samples also showed lower levels of toxic metals. The mean values were as follows; As = 0.014 (± 0.016) mg/kg, Cd = 0.022 (± 0.026) mg/kg, Cr = 0.64 (± 0.42) mg/kg, and Pb = 0.25 (± 0.46) mg/kg and Ni was not detected. Results revealed that Pb, Cd, Cr, and Ni levels in vegetable samples remained within acceptable ranges. This pattern may be attributed to the fact that soil in higher-elevation upcountry areas tends to accumulate fewer contaminated sediments. Apart from that, waterlogged conditions and frequent flooding in lowland fields and river valleys increase the mobility of metals. However, it is essential to perform ongoing toxic metals monitoring of upcountry agricultural soil.

Keywords: Agricultural Soil, Contamination, Environmental Health, Heavy Metal, Water Quality

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IPRC/25/221 Science, Technology, Engineering, Mathematics, and Medicine

Comparative study of machine learning models for predicting crop recommendation in diverse soil conditions

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Efficient crop selection is vital for enhancing agricultural productivity and sustainability, especially under varying environmental and soil conditions. This study leverages machine learning models to recommend suitable crops based on 23 parameters including soil nutrients (N, P, K), temperature, humidity, pH, rainfall, soil moisture, and crop-specific characteristics. A balanced Kaggle dataset, crop recommendation, consists of 100 samples per crop across 22 classes was used. After comprehensive preprocessing involving normalization, missing value imputation, and feature scaling, the data was strategically split 80:20 for training and testing. Four models—Random Forest (RF), XGBoost (XGB), Logistic Regression (LR), and Support Vector Machine (SVM)—were trained with L2 regularization to mitigate overfitting risks, and evaluated using accuracy, precision, recall, and F1-score metrics through 5-fold cross-validation supplemented by held-out testing. Results demonstrated that RF achieved flawless performance with 100% accuracy; precision=1.00, recall=1.00, F1=1.00 across all 22 crops. XGB showed near-perfect results with 99.32% accuracy; macro-avg precision=0.99, recall=0.99, F1=0.99. LR attained moderate efficacy (95.91% accuracy; macro-avg F1=0.96), whereas SVM underperformed (88.86% accuracy; macro-avg F1=0.89) with significant inconsistencies in crops like papaya (recall=0.60). The clear performance hierarchy (RF > XGB > LR > SVM) confirms ensemble methods' superiority in handling complex agricultural feature interactions. These findings highlight how ensemble algorithms can transform precision agriculture by enabling dynamic crop recommendations responsive to real-time soil and climate variables. The near-perfect performance of ensemble methods (RF/XGB) indicates exceptional capability to decode complex agro-ecological patterns, translating highly reliable field-level recommendations that could reduce input waste by a significant rate in precision farming systems. LR's moderate accuracy suggests suitability for preliminary screening, while SVM's limitations highlight challenges with non-linear feature interactions in heterogeneous environments. Future work will be done to validate models against multi-regional field data and explore feature optimization to enhance operational efficiency in resource-constrained farming environments.

Keywords: crop recommendation systems, machine learning, soil, supervised classification, sustainable farming

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IPRC/25/225 Science, Technology, Engineering, Mathematics, and Medicine

Prime gap insights: A Python-based implementation of the segmented sieve

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Prime numbers and their gaps play a fundamental role in number theory and computational mathematics. This study presents a Python-based implementation of the segmented sieve algorithm to efficiently compute prime numbers up to 10^9. The approach improves computational feasibility by dividing the range into manageable segments, enabling large-scale prime generation with reduced memory use. From the dataset generated of 50,847,534 primes and 50,847,533 prime gaps, statistical tests were applied to evaluate their distributional properties. The Chi-Square test rejected uniformity ($\chi^2 = 3.19\times10^8$, $p < 0.001$), confirming that gaps are not equally distributed. Kolmogorov–Smirnov tests similarly rejected both normality ($D = 0.153$, $p < 0.001$) and exponential distribution ($D = 0.100$, $p < 0.001$), indicating that prime gaps cannot be modelled by standard probabilistic distributions. Instead, their structure is governed by underlying number-theoretic principles. The predominance of gap = 6 (~6.09 million instances) was consistent with Hardy–Littlewood's k-tuple conjecture, which predicted a higher frequency of "sexy prime" pairs due to modular congruence properties. In contrast, twin primes (gap = 2) occurred ~3.42 million times, supporting the conjecture that such pairs decrease in relative density as $n\to\infty$ although they remained infinite in occurrence. These results highlighted that prime gaps are shaped by structured number-theoretical patterns rather than random variation. The computational framework developed here is scalable to larger ranges and offers a practical tool for testing conjectures and refining models in analytic number theory. More broadly, this work underscores the value of integrating computational experiments with statistical analysis to strengthen the connection between numerical evidence and theoretical predictions.

Keywords: prime gaps, segmented sieve, statistical distribution, Hardy–Littlewood conjecture, twin primes

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IPRC/25/226 Science, Technology, Engineering, Mathematics, and Medicine

Innovative application of the Criegee oxidation mechanism to differentiate refined coconut oil produced from fresh crude coconut oil and used coconut oil

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Coconut oil is a popular dietary fat known for its unique taste and nutritional benefits. Refining, bleaching, and deodorizing (RBD) transform crude coconut oil into a neutral form suitable for culinary applications. However, concerns have arisen regarding refining and marketing previously used coconut oil as fresh refined oil, often driven by corporate interests. Used oil undergoes oxidative degradation and polymerization, forming toxic and potentially carcinogenic lipid compounds. Prolonged consumption of such adulterated oils may undermine human antioxidant defenses and contribute to hypertension, inflammation, and genetic mutations. Despite the clear distinctions between refined fresh and refined used coconut oil, current quality control measures do not adequately differentiate between the two. This study comprised a novel quality assurance method based on the Criegee oxidation mechanism to address this issue. A total of 75 oil samples from each origin were analyzed. Repeated heating oxidizes triglycerides into mono- and diglycerides, increasing the proportion of monoglycerides in used oils. Since refining does not eliminate glycerides, the monoglyceride content is a potential marker for detecting oil adulteration. In this method, 1-monoglycerides were oxidized to aldehydes through the Criegee mechanism using lead tetra acetate as the oxidizing agent. These aldehydes were subsequently quantified spectrophotometrically and qualitatively using a reference colour chart with predefined absorbance cut-off values. The results indicated that the absorbance values of refined used oil were significantly higher ($P \leq 0.05$) than those of refined fresh oil. Logistic regression analysis and receiver operating characteristic (ROC) curve evaluation revealed an area under the curve (AUC) of 1.00, with 100% sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) at a cut-off absorbance of 0.3234. This straightforward and reliable technique provides a practical solution for regulatory authorities and industry stakeholders to authenticate coconut oil quality, ensuring consumer safety and upholding public health standards.

Keywords: Adulterated, Criegee oxidation, 1-monoglyceride, Spectrophotometry

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IPRC/25/227 Science, Technology, Engineering, Mathematics, and Medicine

Assessment of mosquito vector competence and filarial parasite prevalence in the Galle district of Sri Lanka

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Lymphatic filariasis (LF) is caused by filarial nematodes such as *Wuchereria bancrofti, Brugia malayi*, and *Brugia timori*, and transmitted by mosquitoes. Although Sri Lanka achieved the status of elimination of LF as a public health problem in 2016, evidence suggests continued low-level transmission in specific areas, particularly in the Galle District. This study aimed to investigate the potential for LF re-emergence by assessing the mosquito vector abundance, species composition, and the presence of filarial parasites in selected endemic (Balapitiya and Hikkaduwa) and non-endemic (Baddegama and Gonapinuwala) Medical Officer of Health (MOH) areas within the Galle District. Mosquitoes were collected over a three-month period using Gravid Trap (GT) method. The collected specimens were morphologically identified, and female mosquitoes were dissected to detect larval stages of filarial parasites. Additionally, pooled mosquito samples were subjected to DNA extraction followed by Polymerase Chain Reaction (PCR) assays targeting specific genes to detect *W. bancrofti, B. malayi,* and *Dirofilaria repens*. A total of 1,496 mosquitoes were collected, representing several genera including *Culex, Mansonia, Armigeres*, and *Anopheles*. Of these, *Culex quinquefasciatus, Mansonia uniformis*, and *Ma. annulifera* (n=262, 17.51%) were dominant. Dissection revealed the presence of L1 and L2 larval stages of filarial worms in selected samples, while molecular analysis confirmed the presence of *B. malayi* in *Ma. uniformis* and *Ma. annulifera*, and *D. repens* in *Ar. subalbatus*. Although *W. bancrofti* was suspected based on dissection, molecular confirmation was not achieved in this study. The results suggest that competent vectors of LF are still present in both endemic and non-endemic areas, and the detection of *B. malayi* DNA in vector species raises concerns about potential re-emergence or focal transmission. This highlights the need for ongoing entomological surveillance and molecular monitoring, even in regions declared free of LF as a public health problem.

Keywords: Galle district**,** Lymphatic filariasis, Mosquito vectors, Sri Lanka

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IPRC/25/236 Science, Technology, Engineering, Mathematics, and Medicine

The effect of paraxial approximation in vision correction: limitations and implications for optical design

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Vision defects are a significant issue since they directly affect the quality of human life, making it essential to address these defects to enhance productivity. Over the decades, various methods have been developed to correct refractive errors. Among these laser-assisted in situ keratomileusis (LASIK) and contact lenses are considered strong solutions. However, LASIK is an irreversible surgical approach, whereas contact lenses provide a flexible and adjustable alternative. Conceptual contact lens designs have relied on the paraxial approximation (PA) for constructing the anterior surface, where light propagation is simplified under the assumption that rays travel along the optical axis, that is, refraction is completely ignored. This study investigates the effects of PA in vision correction. Two posterior lens surfaces were considered, plane and spherical (special form of quadratic). The corresponding lens thickness distributions were derived under the PA, and the accuracy of these corrections was subsequently evaluated using a ray-tracing approach, a method that models the true propagation of light rays across the complete geometry of the contact lens. Simulations were carried out in MATLAB using secondary data for four types of patient groups, Keratoconus, Astigmatic, Myopic, and Keratoplasty which are commonly associated with highly aberrated eyes. For each patient, retinal image quality after the correction was quantitatively assessed using visual acuity model (VAM) and structural similarity index (SSIM). The VAM analysis confirmed that SSIM values of plane surface ranged 0.90-0.99 and spherical surface ranged 0.70-0.75 indicating that lens designs based on the plane back surface exhibit superior optical performance in terms of aberration correction, compared to designs employing spherical surfaces, which fail to adequately correct for optical aberrations. It is highlighted the effect of PA and how PA fails to achieve real refractive error correction. Therefore, designing anterior surface using full ray-tracing will be the next step.

Keywords: Contact lenses, Paraxial ray approximation, Ray tracing, Visual acuity model

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IPRC/25/246 Science, Technology, Engineering, Mathematics, and Medicine

Assessment of cytotoxic potential of *Erythrina variegata* bark extracts from different Sri Lankan geographical zones: Using brine shrimp lethality assay

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The study was conducted to evaluate the cytotoxicity of methanolic bark extracts of *Erythrina variegata* from three different geographical regions in Sri Lanka—dry, intermediate, and wet zones using Brine Shrimp Lethality Assay (BSLA). The assay aimed to determine if geographical and related environmental variations influence the plant's cytotoxic activity. *Artemia salina* nauplii were exposed to a series of concentrations of extracts (0.195–100 µg/mL), and mortality was observed after 24 hours. Each extract was tested in triplicate. The three zonal extracts presented a clear dose-dependent toxic effect. Calculated LC_{50} values were found to be 43.86 µg/mL for the dry zone, 43.62 µg/mL for the intermediate zone, and 42.35 µg/mL for the wet zone. Based on the Meyer's toxicity index (LC_{50} <100µg/ml), the data revealed a moderate cytotoxicity across all three samples. While wet zone extract proved to be comparatively more cytotoxic, a one-way ANOVA ($F = 0.826$, $p = 0.482$) verified that variation in LC_{50} values among the regions were not significant. The results indicate that *E. Variegata* bark exhibits comparable cytotoxic activity regardless of geographical location, which may reflect the consistency of its bioactive molecules responsible for cytotoxic activity. Consistency across different zones can be utilized for standardizing therapeutic protocols using this plant. In summary, the BSLA validated the moderate cytotoxicity of methanolic bark extract of *E. variegata* and verified its status as a source of bioactive molecule. However, further studies using the most specific cytotoxicity assays and the fraction of each active compound are recommended to evaluate and optimize the therapeutic index and pharmacological safety profile characterization of this medicinal plant.

Keywords: Brine Shrimp Lethality Assay (BSLA), Cytotoxicity, *Erythrina varigata*, Geographical variation

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IPRC/25/250 Science, Technology, Engineering, Mathematics, and Medicine

Phytochemical profiling, and in *vitro* antioxidant, anti-inflammatory, and enzyme inhibition potentials of a traditional Ayurvedic herbal tea

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Sri Lanka has a rich tradition of medical practices which incorporates therapeutic activity of plant components. Scientifically validated evidence for plant-based formulations giving nephroprotective effects remains limited. Therefore, this study investigated a traditional herbal tea formulation prepared using *Phyllanthus emblica* Linn. (Indian gooseberry), *Tinospora cordifolia* (Rasakinda), and *Aerva lanata* var. *rotundifolia* (Pol pala), and evaluated its potential nephroprotective activity through *in vitro* assays. The moisture (9.00 ± 0.12%), total ash (5.77 ± 0.83%), acid-insoluble ash (0.0027 ± 0.0005%), water-soluble ash (2.08 ± 0.13%) content were measured to establish the quality assurance standard measurements. Heavy metal content was within WHO limits: Pb (0.83 ± 0.46 mg/kg), Cd (0.041 ± 0.006 mg/kg), and As (0.036 ± 0.004 mg/kg). Microbial counts (APC: 5952.4 CFU; YMC: 181.8 CFU) were within the recommended limits. GC-MS analysis of steam-distilled, hexane-extracted volatiles revealed eugenol as the major compound. Methanol extract (ME) showed a total phenolic content: 25.6 ± 1.0 mg Gallic Acid Equivalent/g, flavonoids: 6.3 ± 0.6 mg Catechin Equivalent/g, and tannins: 3.60 ± 0.29 mg Catechin E/g. In antioxidant assays, ME showed stronger activity than the standard in DPPH (IC_{50} µg/mL: ME: 6.67 ± 0.05; BHT: 52.04 ± 4.68) and comparable activity in FRAP assay (absorbance at 400 µg/mL: ME: 0.59 ± 0.01; BHT: 0.58 ± 0.06), though weaker in ABTS (IC_{50}: ME: 1119.0 ± 23.3; BHT: 505.7 ± 3.1) assay. The anti-inflammatory activity, as determined by the human red blood cell membrane stabilization assay, showed that ME (IC_{50}: 70.6 ± 1.6 µg/mL) was not significantly different from that of Aspirin (66.9 ± 6.5 µg/mL). ME also showed antidiabetic potential based on α-amylase inhibition at 500 µg/mL (21.6 ± 3.8%), compared to the positive control, Acarbose (96.0 ± 0.5%), and α-glucosidase inhibition outperforming the standard (IC_{50}: ME: 158.8 ± 27.7; Acarbose: 206.7 ± 19.0 µg/mL). Additionally, ME also showed moderate anti-obesity and anti-gout potential based on lipase inhibition (IC_{50}: 460.3 ± 14.3; Orlistat: 147.6 ± 5.6 µg/mL), and xanthine oxidase inhibition (IC_{50}: 910.1 ± 20.1; Allopurinol: 78.6 ± 1.4 µg/mL). Bioactivity, including antioxidant, anti-inflammatory, and enzyme inhibition effects, supports the potential of this formulation for therapeutic applications.

Keywords: Traditional herbal formula, Phytochemical profiling, *In vitro* bioactivity, Antioxidant and anti-inflammatory Activity, Nephroprotective potential

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IPRC/25/268 Science, Technology, Engineering, Mathematics, and Medicine

Nutritional assessment of dried fish varieties commonly consumed in Sri Lanka: implications for protein and salt intake

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Dried fish remains a staple protein source in Sri Lanka, especially in urban and suburban communities of the Colombo District. This study evaluated the protein and salt content of five commonly consumed dried fish species: *Amblygaster leiogaster*, *Stolephorus* sp., *Seriphus politus*, *Carcharhinus* sp., and *Katsuwonus pelamis*. A structured survey of 270 residents identified these species as the most frequently consumed. Protein and salt contents were measured using Micro-Kjeldahl and Modified Mohr's methods, respectively. Data were analyzed using Minitab 2021 with one-way ANOVA and Tukey's post-hoc test ($p<0.05$). Protein levels ranged from 35.6 ± 1.2% to 49.2 ± 1.5%, highest in *A. leiogaster* and *Stolephorus* sp. Salt content varied from 10.8 ± 0.1% to 16.6 ± 0.1%, highest in *Stolephorus* sp. and *Carcharhinus* sp., and lowest in *K. pelamis*. A typical 30 g serving provided 17.8–24.6 g of protein, meeting over 60% of adult daily protein requirement, but also delivered 3.2–4.9 g of salt, approaching the WHO recommended 5 g daily sodium limit. While *Stolephorus* sp. was protein-rich, its high salt content is concerning. Conversely, *K. pelamis* offered a balanced nutritional profile. Survey data normality was evaluated with Anderson-Darling test. Survey findings confirmed 35.6% of participants consumed dried fish daily, alongside carbohydrate-rich foods, for its affordability. These results emphasize dried fish's dual role as a valuable protein source and potential contributor to excessive salt intake, highlighting the need for species-specific consumption guidelines and improved nutritional labeling to enhance public health. Future studies will evaluate how common food preparation methods such as rinsing, soaking, and blanching reduce salt content and recommend practical strategies for consumers.

Keywords: Dried fish, Nutritional analysis, Protein content, Salt intake

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IPRC/25/274 Science, Technology, Engineering, Mathematics, and Medicine

First locally acquired case of visceral Leishmaniasis by *Leishmania orientalis* in Sri Lanka and entomological assessment of disease vectors in the case-reported location

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Visceral leishmaniasis (VL) is a potentially fatal parasitic disease affecting internal organs. In Sri Lanka, cutaneous leishmaniasis (CL) is endemic, and sporadic indigenous VL cases have been reported, all attributed to *Leishmania donovani*. This study reports the first locally acquired VL case caused by *Leishmania orientalis* in Sri Lanka, based on diagnostic, molecular, histopathological, and entomological investigations. A 66-year-old male with no history of overseas travel presented with prolonged fever, generalized weakness, dyspnoea, weight loss, and pancytopenia. Extensive diagnostic investigations were conducted, including imaging, hematological assessments, and a left axillary lymph node biopsy. Histopathological examination revealed *Leishman–Donovan* bodies, confirming VL. The Polymerase Chain Reaction (PCR) amplification targeting the small subunit rRNA gene of *Leishmania* genus was performed on bone marrow aspirate DNA, followed by bidirectional Sanger sequencing. Sequence analysis revealed 98.9% similarity to *L. orientalis* (GenBank accession no. PQ727038), confirming molecular identification and validating the result. Monthly entomological surveys (September–December 2024) conducted within a 5 km radius of the patient's residence identified *Phlebotomus argentipes* the known vector of *L. donovani* and *Sergentomyia zeylanica*. Relative abundance and species composition were descriptively analyzed, showing vector presence and exophilic behavior near the patient's home, confirming the possibility of local transmission. The patient was treated with intravenous amphotericin B deoxycholate (1 mg/kg/day) for two weeks followed by oral itraconazole (400 mg/day). Follow-up assessments showed full clinical recovery without recurrence. These findings provide the first evidence of locally acquired *L. orientalis* infection in Sri Lanka, highlighting the need for enhanced molecular surveillance and entomological monitoring.

Keywords: *Leishmania orientalis*, molecular diagnostics, sand flies, Sri Lanka, Visceral leishmaniasis.

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IPRC/25/283 Science, Technology, Engineering, Mathematics, and Medicine

Deep learning-based identification of endemic and endangered fish species in Sri Lanka

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Accurate identification of fish species is vital for biodiversity conservation and sustainable fisheries management, particularly in Sri Lanka, an island nation in the Indian Ocean with over 60 freshwater species (including 26 endemic species) and diverse marine ecosystems. The visual similarity among endemic and endangered fish species and the limitations of conventional identification methods pose considerable challenges, often requiring expert knowledge and extensive time. This research addresses these challenges by developing an automated fish species identification system based on deep learning techniques to enhance classification accuracy and efficiency. Two convolutional neural network (CNN) architectures, MobileNetV2 and a custom Sequential CNN, were trained and evaluated using a dataset of 2,952 RGB images (256 × 256 pixels) representing five fish species: Dawkinsia Singhala (n=185), Puntius Titteya (n=613), Black Ruby Barb (n=154), Red Sea Bream (n=1000), and Black Sea Sprat (n=1000), including endemic and threatened varieties from Sri Lankan freshwater and marine habitats. Data augmentation techniques including rotation, flipping, and zooming enhanced dataset robustness. The MobileNetV2 model achieved 100% classification accuracy with a loss of 0.00131, making it suitable for resource-constrained environments such as mobile devices. Sequential CNN demonstrated 99.79% accuracy with a loss of 0.0175, offering superior generalization capabilities. This study demonstrates the potential of integrating deep learning with ecological assessment to provide a scalable, rapid identification tool supporting fisheries management, environmental monitoring, and conservation policymaking in Sri Lanka. Future work will expand species coverage, refine model architectures, and develop real-time mobile applications for in-field biodiversity conservation.

Keywords: Automated classification, Convolutional Neural Networks, Deep learning, Fish species identification, MobileNetV2

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IPRC/25/04 Science, Technology, Engineering, Mathematics, and Medicine

Parental knowledge, attitudes, and pre-hospital practices in paediatric snakebite management: A cross-sectional study from rural Sri Lanka

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Paediatric snakebites remain a major public health concern in rural Sri Lanka, particularly affecting children under five years of age. This study aimed to assess parental attitudes, knowledge sources, and pre-hospital preventive practices related to paediatric snakebite prevention and management in two high-risk districts: Ampara and Polonnaruwa. A descriptive cross-sectional design was employed using cluster sampling facilitated by Public Health Midwives (PHMs), targeting parents with children under five. A structured, self-administered questionnaire collected data on demographics, attitudes toward snakes, knowledge sources, snake identification ability, and first-aid practices. A total of 518 parents participated (94.2% mothers, n=487), with a mean age of 27 years (SD=6.4). An overwhelming 92.7% (n=480) reported extreme fear of snakes, and 23.7% (n=122) believed snakes should be killed after biting, while 18.0% believed snakes take revenge. Significant associations were found between extreme fear and being a mother (p=0.001) or lacking first-aid training (p=0.035). Traditional healing reliance (32.6%, n=169) was significantly associated with low socioeconomic status and lower parental education (p=0.001). Social media (42.1%, n=218) was the most common knowledge source. Knowledge on snake identification was mixed; while 98.3% (n=509) correctly identified cobras, only 34.6% (n=179) recognized Russell's viper, and 82% (n=424) mistakenly believed rat snakes to be venomous. Prior first-aid training was significantly associated with improved knowledge on snake identification (p=0.02), treatment (p=0.00), and pre-hospital care (p=0.01). However, nearly 30% of parents incorrectly believed antivenom should be universally administered. These findings highlight the need for targeted, community-based educational interventions and integration of snakebite first-aid training into public health initiatives to improve outcomes for children in snakebite-endemic rural areas.

Keywords: Children, First aid, Parental knowledge, Rural Sri Lanka, Snakebite prevention.

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IPRC/25/12 Science, Technology, Engineering, Mathematics, and Medicine

Nutritional status and perceived barriers for nutrition among patients with cancer at a selected hospital in Sri Lanka

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Cancer is a major worldwide killer and accounts for about one- sixth of all deaths. Although the role of nutrition in cancer treatment is already widely known, there are many obstacles on the way to providing sufficient nutrition for the patient. Therefore, this study aimed to assess the nutritional status and perceived barriers for nutrition among cancer patients at a selected hospital in, Sri Lanka. The study was conducted as a descriptive cross-sectional study among 183 patients diagnosed with cancer using simple random sampling. Data was collected by using a researcher- developed, pre- tested, interviewer-administered questionnaire including Mini Nutritional Assessment (MNA). Ethical clearance was obtained from the Ethics Review Committee of KAATSU International University, and data were analysed using SPSS version 25. The mean age of this population was 46.38 + 15.89. Among participants, the majority were females (51.4%), Sinhalese (72.7%), Buddhists (66.7%), married (57.9%) and employed (53.6%). 48.6% of them were undergoing chemotherapy, 13.1% were undergoing radiation therapy, and 38.3% had undergone surgery. The majority (54.1%) were in the normal weight category, and 29% were in the underweight category according to BMI level. Based on the MNA scale, 36.6% were well nourished, 36.1% were at risk for malnutrition, and 27.3% were malnourished. The majority (59.6%) had moderate perceived barriers, 26.2% had high perceived barriers, and 14.2% had low perceived barriers for their nutrition. Many agreed that, treatment side effects (50.8%), fatigue & nausea (51.4%), emotional stress (65%), access to healthy food (45.4%), and financial constraints (62.3%) are barriers to nutrition. This study has revealed a significant prevalence of malnutrition and nutritional risk among cancer patients, with 27.3% of patients classified as malnourished and 36.1% at risk of malnutrition. The findings underscore the critical role of nutritional support in cancer care, as well as the barriers that hinder proper nutrition. This highlights the imperative of specific nutritional consultations.

Keywords: Barriers, Cancer, Nutritional status

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IPRC/25/113 Science, Technology, Engineering, Mathematics, and Medicine

Integration of technology in clinical education

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Clinical training is crucial in medical education for the development of essential skills. There is growing evidence that the traditional approach is being challenged, and teachers and students should look into novel methods to address the gaps in clinical skills. The study's objective was to explore the learning and teaching methods used in clinical education by medical students, clinical teachers, and medical educationists. Data were collected through focus group discussions with students and individual interviews with clinical teachers and medical educationists. A qualitative research design was used. Purposive sampling was the method used to gather the participants. Four focus group discussions with medical students, eight individual interviews with clinical teachers, and four individual interviews with medical educationists were conducted until data saturation. The collected data were analyzed thematically. Issues were categorized; altogether, there were three themes identified in each encounter. While students preferred to learn at the bedside, they appreciated the incorporation of digital technology in learning, like online case-based discussions and internet searches, while engaging in self-directed learning. They had group discussions with peers late at night via the Zoom platform when time was an issue, and had useful discussions with clinical teachers through online chat applications such as WhatsApp. Learning resuscitation techniques on simulators was useful. Teachers and students stated that online learning was beneficial during times of crisis. Teaching by external faculty via the Zoom platform was beneficial. Medical educationists appreciated the learning facilities with technological advancements. They suggested that simulation-based learning could be encouraged among students before they handle real patients, allowing them to utilize internet facilities to stay updated. In conclusion, advances in technology should be increasingly utilized to maximize learning capacity in clinical education among students.

Keywords: Clinical education, Online learning, Technology.

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IPRC/25/219 Science, Technology, Engineering, Mathematics, and Medicine

Association between gestational weight gain (GWG) and neonatal birth weight (NBW) in a Sri Lankan maternal cohort

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Gestational weight gain (GWG) is a critical determinant of neonatal birth weight (NBW). Both small for gestational age (SGA) and large for gestational age (LGA) babies are associated with an increased risk of early-onset cardiovascular and other non-communicable diseases. The primary objective of this study was to investigate the relationship between GWG and NBW in a Sri Lankan cohort. A total of 1537 pregnant mothers were randomly recruited from the Antenatal Clinic of Teaching Hospital Peradeniya. Their demographic and medical details were collected using an interviewer-administered questionnaire. Of these, only 1060 mother-infant pairs were selected for this prospective observational cohort study, who were term neonates without any birth defects. The NBW was measured at delivery. Binary logistic regression, Spearman Correlation test and Chi-Squared test of independence were used for the data analysis by SPSS version 27. The median maternal age and GWG were 29 (± 7.00) years and 9.50 (± 7.00) kg, respectively. The median NBW was 2900 (± 600) g. Out of 1060 mothers, 119 (11.2%) and 587 (55.4%) had excessive and inadequate GWG, respectively, according to their pre-pregnancy BMI. A statistically significant weak positive correlation was found between NBW and GWG ($p < 0.05$, $r = 0.135$). As GWG increased, there was an increased likelihood of elevated NBW, indicating a significant association between GWG and NBW ($p < 0.05$). The adjusted odds ratio (aOR) for having LGA babies for mothers with excessive GWG was 1.94 (CI: 0.985-3.842). Additionally, the aOR for having SGA babies for mothers with inadequate GWG was 1.02 (CI: 0.383-2.739). Furthermore, GWG percentage significantly predicted NBW ($B= 7.30$, $p < 0.05$) indicating each 1% of the GWG increase would result in 7 g of increase in NBW. This study concludes that GWG had a significant association with NBW. Maintaining appropriate levels of GWG is important to improve birth outcomes in Sri Lanka.

Keywords: Birth outcomes, Gestational weight gain, Neonatal birth weight.

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IPRC/25/237 Science, Technology, Engineering, Mathematics, and Medicine

Countering lung cancer in Sri Lanka: the *Beedi* obstacle

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Lung cancer incidence is strongly associated with tobacco smoking. Cigarettes and *beedis* are considered the two main smoked tobacco products in Sri Lanka. *Beedi* smoke has a higher risk of lung cancer compared to cigarettes due to its higher concentration of toxic agents. Multiple interventions for control and prevention have been taken by Sri Lanka to counter the health threat of smoking, mainly targeting cigarettes, with less emphasis on *beedi*. Here, we analyse how trends in sales of smoked tobacco products have affected lung cancer incidence in Sri Lanka. Secondary data from research and articles on tobacco usage, sales and lung cancer incidence in Sri Lanka were analysed. Pearson correlations between variables were analysed using IBM SPSS software, version 27. Despite a price hike of 8 rupees and 50 cents between 2007 and 2022, *beedi* remains a much cheaper alternative due to the parallel increase in cigarette prices by 71 rupees. The declining trend in cigarette sales is significantly correlated with the rising trend in *beedi* sales ($r = -0.921$, $p < 0.001$), signifying a shift of consumers to *beedi*. One potential factor contributing to the lack of decline in crude rates of lung cancer incidence despite legislative interventions is cigarette smokers switching to *beedi* rather than quitting smoking. Interventions to reduce cigarette smoking have been successful, but focus should be expanded to *beedi* in order to curb rising lung cancer incidence. We recommend *beedi* be less affordable and regulated under stringent legislative interventions.

Keywords: *Beedi*, Cigarettes, Lung cancer, Smoking.

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IPRC/25/248 Science, Technology, Engineering, Mathematics, and Medicine

Neuroprotective potential of *Salicornia brachiata* against Alzheimer's disease and oxidative stress induced by aluminium chloride in Wistar rats

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Alzheimer's disease is a long-term neurodegenerative condition that is characterised by a decline in cognitive abilities and memory, which is linked to oxidative stress and a reduction in cholinergic function. *Salicornia brachiata* (SB) is a halophyte that exhibits important therapeutic potential besides its phytochemical richness. The study aimed to examine the neuroprotective potential of the raw aerial part of SB against the oxidative damage induced by $AlCl_3$ in an Alzheimer's model of Wistar rats. In this study rats were divided into four groups (n = 6): Group I (negative control), Group II (Alzheimer's model) was given $AlCl_3$ (175 mg/Kg), Group III (positive control) was given Donepezil (5 mg/Kg) before $AlCl_3$ (175 mg/Kg), and Group IV (test control) was given SB (700 mg/Kg) before $AlCl_3$ (175 mg/Kg). All treatments were administered orally for 28 days. Biochemical and histopathological tests were performed on the hippocampus and frontal cortex. Acetylcholinesterase activity (AChE), thiobarbituric acid reactive substances (TBARS), and total protein were measured. The activity of AChE for both the hippocampus and the frontal cortex was significantly increased in the Alzheimer's model compared to the negative control ($p < 0.05$). Treatments with Donepezil and SB resulted in a significant decrease in AChE activity compared to the Alzheimer's model ($p<0.05$). The levels of TBARS were much higher in the Alzheimer's model compared to negative controls ($p<0.05$). The SB and Donepezil treatments significantly reduced the level of TBARS compared to the Alzheimer's model ($p<0.05$). The same tendency was observed in total protein levels. Histological examination revealed a significant neuronal survival in the SB and Donepezil treated groups and less neurodegeneration in the brain compared to the $AlCl_3$ treated group. These results indicate that SB has notable neuroprotective properties and can be considered as an efficient natural therapeutic agent to prevent Alzheimer's disease.

Keywords: Alzheimer's disease, halophytic plant, neurodegenerative disease, oxidative stress, *Salicornia brachiate.*

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IPRC/25/259 Science, Technology, Engineering, Mathematics, and Medicine

Hypolipidemic potential of *Karavyadee Kvatha* poly-herbal formula

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Hyperlipidemia explained in Ayurveda as *Medoroga* causes heart diseases which may lead to sudden death. *Karavyadee Kvatha*, preserved form decoction prepared according to Ayurveda Pharmacopeia was purchased from Ayurveda Drug Corporation, Sri Lanka. The objective of the experimental study was to analyse the product for lipid lowering property with its toxicity study. Adult male Wistar rats' weighing 200-250g were obtained from the Medical Research Institute of Sri Lanka were maintained under standard animal house conditions at the Department of Zoology, University of Colombo. All rats were acclimatized at least for 7 days before the commencement of the experiment. The rats were randomly assigned into four groups (n=9), the drug was administered twice daily morning and evening in different doses (mL) low, mid and high: 1, 2, and 4 mL, respectively for 30 consecutive days. Blood was collected from rats' day one before the treatment, two weeks, four weeks of the test period and serum lipid profile was estimated using the enzyme assay kits. Toxicity was evaluated for the group administered the highest dose for 45 days, assessed toxic parameters for liver (SGOT/SGPT), kidney (urea and creatinine), organ weights and structures were observed. Percentage values in reduction of blood cholesterol levels were calculated and analyzed using Mann-Whitney U-test, significance compared at ($p<0.05$) with control. Results showed significant reduction of total cholesterol fraction of lipid profile reduced in 39.2% and 30.5% (95% CI) mid and highest doses, respectively, compared to the control at second week of treatment while LDL significantly reduced at the same duration in 57.7%. It was not shown any changes in the triglyceride level. The SGOT/ SGPT levels (UI) as well as urea and creatinine levels (mg/dl) were not increased compared to control 19.06 ± 3.2, 16.66 ± 3.0, and 15.78 ± 2.4/12.22 ± 1.6 while 31.0 ± 0.7, 27.74 ± 0.5 and 16.93 ± 3.4, 14.57 ± 3.2, respectively. No toxic effects on organ structures and behavioral activities of the animals were noted. These results evidenced that this herbal formula is a safer herbal medication for hyperlipidaemia.

Key words: Hyperlipidaemia, Karavyadee decoction, LDL, safety, Total cholesterol.

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IPRC/25/260 Science, Technology, Engineering, Mathematics, and Medicine

Evaluation of hypolipidaemic activity and safety of *Arogyawardhani wati:* Ayurveda formula

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Arogyawardhani wati:pill is a herbo-mineral preparation used in Ayurveda hospitals, that mentioned in the Ayurveda Pharmacopia of Sri Lanka was purchased from Ayurveda Drug Corporation. The objective of the present study was to evaluate the efficacy of *Arogyawardhani wati* for lipid lowering property with safety. Adult male Wistar rats' weighing 200-250g were obtained from the Medical Research Institute of Sri Lanka were maintained under standard animal house condition Department of Zoology, University of Colombo. The rats were randomly assigned into three groups (n=9) and orally administered with *Arogyawardhani wati* (in1ml of distilled water) and equal volume of distilled water was taken for the rats in control group. The drug was administered twice daily morning and evening in different doses low, mid and high (8.5mg, 17mg, and 34mg) for 30 consecutive days. Blood was collected from rats' day one before the treatment, two weeks, four weeks of the test period and serum cholesterol levels were estimated using the enzyme assay kits. Toxicity was assessed in rats that were administered the highest dose of the drug for 45 days and observed the toxic parameters for liver (SGOT/SGPT), kidney (urea and creatinine). The organ weights and organ structures were analyzed. Percentage values in the reduction of blood cholesterol levels were calculated and analyzed using Mann-Whitney U-test significance ($p<0.05$) and compared with the control group. Results revealed a significant reduction of triglycerides by 34.4%. None of the three doses showed a significant reduction in total cholesterol levels. However, high and mid doses increased High Density Lipoprotein (HDL) by 29.3% and 27.2% respectively. Low-Density Lipoprotein (LDL) levels were significantly reduced by 41.8% at the 2nd week of administration. SGOT and SGPT (UI) were not altered compared to control (19.06 ± 3.2, 16.66 ± 3.0 respectively). Similarly, urea and creatinine levels (mg/dl) (31.0 ± 0.7, 27.74 ± 0.5 and 16.93 ± 3.4, 14.57 ± 3.2 respectively) showed no significant changes. No toxic effects were observed in organ structures in the behavioural activities of the animals. These results suggest that this is a safe lipid lowering drug for the management of hyperlipidaemia.

Key words: Ayurveda formula, Hyperlipidaemia, HDL, LDL, Safety, Triglycerides.

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IPRC/25/267 Science, Technology, Engineering, Mathematics, and Medicine

Neuroprotective effect of *Rajata Bhasma* against aluminum chloride-induced Alzheimer's disease and oxidative stress in Wistar rats

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Rajata Bhasma (RB), a traditional Ayurvedic herbo-metallic formulation, has been historically used for neurological, cardiac, and age-related ailments. This study aimed to explore its neuroprotective effects in an Alzheimer's disease (AD) rat model induced by aluminium chloride ($AlCl_3$), a neurotoxin associated with oxidative stress and cognitive decline. Treatment options for AD are currently limited and often burdened with adverse side effects, prompting the need for safer therapeutic alternatives. In this study, rats were divided into four groups: normal control, disease control ($AlCl_3$ 300 mg/kg orally for 28 days), positive control (Donepezil 5 mg/kg orally prior to $AlCl_3$ 300 mg/kg orally for 28 days), and therapeutic group (RB 20 mg/kg orally prior to $AlCl_3$300 mg/kg orally for 28 days). After the treatment period, the hippocampus and frontal cortex; the regions significantly affected in AD were examined for oxidative stress and markers of neurotoxicity. RB significantly inhibited acetylcholinesterase (AChE) activity in the hippocampus compared to the positive control group treated with Donepezil ($p>0.05$) and in the frontal cortex ($p<0.05$) compared to the disease control, suggesting amelioration of cholinergic dysfunction. Lipid peroxidation, measured by malondialdehyde (MDA) levels, was lower in both brain regions in RB-treated rats compared to the diseased control group ($p<0.05$). The frontal cortex of RB treated group showed lower MDA content similar to that of the positive control group, suggesting both RB and donepezil treatments have exerted comparable antioxidant effects. Additionally, total protein content was significantly restored in both brain areas ($p<0.05$), indicating tissue integrity. Histopathological analysis confirmed reduced neurodegeneration, fewer microglial cells, and decreased vacuolization in RB-treated animals compared to diseased rats. These findings highlight RB's potential to mitigate oxidative stress and neurotoxicity in AD, supporting its traditional use and warranting further investigation into its therapeutic role in neurodegenerative conditions.

Key words: Aluminum chloride induced Alzheimer's, Alzheimer's disease, Neurodegeneration, Oxidative stress, Rajata Bhasma.

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IPRC/25/272 Science, Technology, Engineering, Mathematics, and Medicine

Potential risk factors for transmission of intestinal nematodes infections and parental awareness in a selected paediatric population in Gampaha District, Sri Lanka

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Intestinal parasitic helminth infections remain a global public health concern, with children being one of the most vulnerable groups. In Sri Lanka, declining disease burden due to mass deworming has led to reduced public awareness regarding transmission and prevention. This study aimed to assess parental awareness of potential risk factors for intestinal helminthic infections. A cross-sectional survey was conducted among children admitted to the paediatric wards of Colombo North Teaching Hospital, Ragama, between August 2024 to February 2025. Awareness among parents was assessed using a structured questionnaire covering three domains: transmission, prevention, and treatment. Responses were scored and categorized as Very Good (>80%), Good (60–79%), Average (40–59%), or Poor (<39%). Risk behaviors contributing to transmission were also recorded. Descriptive statistics were used for analysis. Of the 314 participants who consented, 56.69% were male (n=178). Most families had 4 or 5 members, with 32.80% (n=103) having one child. Co-sleeping was absent in 57.96% (n=182). Although 91.4% (n=285) had received deworming, only 45.54% (n=143) had been treated in the past six months, and 58.6% (n=184) reported simultaneous deworming of the household. Identified common risk factors for transmission included playing on the ground (92.35%; n=290), presence of dirt under fingernails (50.63%; n=159), playing with soil (68.78%; n=216), and poor hand hygiene practices. Awareness of enterobiasis was relatively high: transmission (Average – 40.96%), prevention (Very Good – 82.56%), and treatment (Very Good – 90.68%). Awareness of soil-transmitted helminths (STHs) was significantly lower: transmission (Poor – 38.53%), prevention (Poor – 34.85%), and treatment (Average – 52.15%). These findings reveal significant behavioral risk factors and gaps in parental knowledge, highlighting the need for enhanced health education to sustain the gains from national deworming programs.

Keywords: Awareness, Intestinal helminths, Risk factors

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IPRC/25/23 Science, Technology, Engineering, Mathematics, and Medicine

Effect of cement types on the oviposition behavior of dengue vectors at urban setup

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Dengue is a rapidly spreading vector-borne disease primarily transmitted by Aedes mosquitoes, which typically breed in artificial water-holding containers. Urban construction sites are increasingly recognized as major mosquito breeding grounds due to the abundance of such surfaces. However, limited research has explored how construction materials, particularly different types of cement, affect Aedes mosquito oviposition behavior. This field-based experimental study evaluated the influence of various cement substrates on oviposition preference under natural conditions in urban Sri Lanka. The study was conducted over seven months (September 2024 – March 2025) across three Grama Niladhari divisions: Kolonnawa, Salamulla, and Orugodawatta in the Colombo district. A total of 480 ovitraps were deployed across 60 randomly selected households, using four substrate types: control (no cement), blended hydraulic cement (BHC), ordinary portland cement (OPC), and portland limestone cement (PCC). Each household received eight traps (four indoors and four outdoors), one for each substrate. Water quality parameters (pH, turbidity, conductivity, and salinity) were measured at the time of placement. Egg counts were recorded weekly, and data were analyzed using a zero-inflated negative binomial (ZINB) regression model to determine significant predictors of oviposition activity and trap negativity. Traps made with BHC and PCC substrates showed significantly fewer eggs than the control (BHC: $\beta = -0.402$; $P = 0.014$, PCC: $\beta = -0.527$; $P = 0.001$) and had a higher likelihood of being egg-negative (BHC: $\beta = 1.025$; $P = 0.002$, PCC: $\beta = 0.941$; $P = 0.003$). Outdoor traps collected more eggs than indoor ones ($\beta = 0.326$; $P = 0.021$), though with increased variability in zero-egg observations. Among water quality variables, only conductivity was negatively associated with egg counts ($P = 0.036$). These findings suggest that certain cement types, especially BHC and PCC, may deter Aedes oviposition and help in reducing breeding sites when used in construction settings.

Keywords: *Aedes*, cement, dengue, vector control

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IPRC/25/41 Science, Technology, Engineering, Mathematics, and Medicine

Impacts of polyethylene terephthalate microplastic fibers on the freshwater zooplankton *Moina macrocopa*

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Freshwater ecosystems face significant threats from pollutants, including microplastics. This study assessed the impacts of polyethylene terephthalate (PET) microplastic fibers on *Moina macrocopa*. *M. macrocopa* were cultured under laboratory conditions for several generations. PET fibers (520 ± 325 µm in length) were prepared from a locally sourced material, after the polymer type being confirmed by Fourier Transform Infrared (FTIR) spectroscopy. Bioassays were conducted under static-renewal conditions using standard protocols. An acute immobilization test was performed using a series of PET fiber concentrations (i.e., 0, 1, 5, 10, 50, and 100 mg L^{-1}) with three replicates per treatment and 10 neonates (<24 h old) per replicate for 48 h. Endpoints included survival, growth, and heartbeat. A chronic reproduction test was conducted for 7 days using a range of PET fiber concentrations (i.e., 0, 0.01, 0.1, 1, 5, and 10 mg L^{-1}) with ten replicates of single neonates per treatment. Endpoints included several reproduction-related parameters. All statistical analyses were performed using Minitab 22 software. According to the results of the acute toxicity test, the 48-h LC50 value was 56 (41.09–83.37) mg L^{-1} (Probit analysis), and a significant reduction in survival, growth, and heartbeat was observed at ≥5, ≥10, and ≥100 mg L^{-1}, respectively (p<0.05**,** one-way ANOVA). According to the results of the chronic reproduction test, the total reproduction was significantly affected at ≥5 mgL^{-1} (p<0.05, one-way ANOVA). A dose-dependent effect was observed on other reproduction-related endpoints including the size, time to first brood, and total broods, but it was not statistically significant. These findings highlight the potential of PET microplastic fibers to disrupt the physiology of *M. macrocopa* and reproduction even at low concentrations, posing broader ecosystem-wide impacts. Therefore, there is a need to regulate microplastic fiber pollution, and future research should examine the toxicity pathways and evaluate combined effects with other pollutants for improved risk assessment.

Keywords: freshwater ecotoxicology, microplastic fibers, *Moina macrocopa,* zooplankton

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IPRC/25/42 Science, Technology, Engineering, Mathematics, and Medicine

Synthetic consortium of two Bacillus strains elicits induced defense responses in Pea plants against Fusarium wilt disease through metabolomic reprogramming

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Plant growth-promoting beneficial microbes are extensively studied to protect plants against diseases. In this study, it was attempted to manage Fusarium wilt disease of Pea plants using two *Bacillus* strains (*Bacillus aryabhattai* strain Z-48 and *B. cereus* strain Z-53) either alone or in a synthetic consortium. Pea plants were grown in a potting mix drenched with bacterial strains and inoculated with *Fusarium oxysporum.* Twenty days after inoculation plant growth parameters such as plant height, root length, fresh and dry weight, were measured. The time-course quantification of defense-related enzymes (peroxidase, polyphenol oxidase and phenylalanine ammonia lyase) and photosynthetic pigments (chlorophyll and carotenoid contents) was performed using spectrophotometric method. Non-targeted metabolite profiling was performed on an UPLC-QQQ-ESI-MS instrument under positive mode. Five biological replicates were included in each treatment, and the experiments were repeated twice. The application of a synthetic consortium of both *Bacillus* strains (Z-48 + Z-53) significantly (P<0.05) suppressed Fusarium wilt disease up to 54.3%. Results showed that in addition to protection against Fusarium wilt, both bacterial strains showed significantly (P<0.05) higher growth of plants both in the presence and absence of the wilt pathogen. Likewise, the application of the *Bacillus* consortium significantly (P<0.05) increased the accumulation of defense-related enzymes, and photosynthetic pigments in Pea plants. The metabolomic profiling indicated that the Fusarium wilt pathogen negatively affected the metabolites in Pea plants belonging to different classes. In contrast, soil-drenched application of a *Bacillus* consortium (Z-48 + Z-53) to pea plants subsequently challenged with the wilt pathogen showed an ameliorative effect for different metabolites. The PCA analysis clearly separated Pea plants challenged with wilt pathogen from the plants inoculated with *Bacillus* consortium. The multivariate analysis showed strong positive relationships between treatment effects and different metabolites, including phenylalanine, ursolic acid, and glycerol-3-phosphocholine. These findings unveil the intricate beneficial interplay between this synthetic consortium of *Bacillus* strains and Pea plants in the context of Fusarium wilt management and plant growth promotion. This study also proved the potential of this synthetic consortium to be applicable in the field for sustainable farming.

Keywords: Bacillus, Fusarium wilt, growth promotion, induced resistance, synthetic consortium

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IPRC/25/54 Science, Technology, Engineering, Mathematics, and Medicine

An innovative computational approach to the transportation problem using MATLAB

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The transportation problem (TP) is a classical and fundamental model in operations research used to determine the most cost-effective allocation of resources to transport products from multiple sources to warehouses, aiming to minimize total transportation expenses. TP has considerable significance in the fields of logistics, distribution channels, and supply chain management. Traditionally, several approaches such as the North-West corner method, least cost method, Vogel's approximation method, row minima method, and column minima method are used to find an initial basic feasible solution, while optimization is achieved through traditional methods like the stepping stone method and the modified distribution method. However, when applied to large-scale problems, these methods become highly time-consuming and impractical to perform manually due to computational complexity. To address this challenge, a new computational method has been developed in MATLAB to determine the optimum or near-optimum solution of the transportation problem. The methodology involves entering the cost matrix, supply values, and demand values into MATLAB, then using a smart computational strategy to calculate the opportunity cost at each iteration, guiding the allocation process toward optimality. Based on the input data, the MATLAB program successfully determines the total transportation cost, identifies the optimal resource distribution, and computes the total central processing unit time consumed during computation. Additionally, the proposed MATLAB program provides a clear graphical representation of the relationship between computational time and the number of iterations, enabling a visual assessment of algorithm efficiency. The performance and reliability of the method were thoroughly evaluated using benchmark transportation problems and a variety of randomly generated datasets, covering both balanced and unbalanced cases to ensure broad applicability. Comparative analysis with standard solution approaches demonstrated that the proposed method consistently achieves improved computational efficiency, shorter execution times, and 100% correctness in delivering better solutions, with 81.25% of cases yielding the exact optimal solution.

Keywords: central processing unit time, initial basic feasible solution, MATLAB, optimum solution, transportation problem

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IPRC/25/57 Science, Technology, Engineering, Mathematics, and Medicine

(m,n)-semi-regular open sets in bi-generalized topological spaces

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The study and analysis of bi-generalized topological spaces are motivated by the desire to explore broader generalizations of topological spaces, which allows for a more flexible structure in examining topological properties and their relationships. Boonpok introduced the notion of bi-generalized topological space in 2010. The objective of this study is to introduce a new set called (m,n)-semi-regular open set and investigate its properties. For a non-empty set X, the triple (X,μ_1,μ_2) is a bi-generalized topological space, where μ_1 and μ_2 are generalized topologies on X. The members of μ_m are called μ_m-open sets, m =1,2. The complement of μ_m-open set is μ_m-closed set. In a bi-generalized topological space (X,μ_1,μ_2), a subset A is called (m,n)-semi-regular open if $cl_{\mu_n}\left(int_{\mu_m}(A)\right)=A$, where $m,n=1,2$ with $m\neq n$. In our study, we first show that the union or intersection of two (m,n)-semi-regular open sets need not be (m,n)-semi-regular open. Second, we show that every (m,n)- open set is (m,n)-semi-regular open when the set is μ_n-closed. Third, we prove the following: Let A be μ_m-open set. Then A is (m,n)-semi-regular open if and only if A is μ_n-closed. Next, we show that an (m,n)-semi-regular open set is μ_n-closed and (m,n)-semi-open. Moreover, every (m,n)-semi-regular open set need not be (m,n)-pre open. The reverse of this result is also not true in general. When an (m,n)-pre open set is μ_n-closed, it is (m,n)-semi-regular open. Finally, we prove that every (m,n)-semi-regular open set is (m,n)-regular open when the set is μ_m-open. Also, every (m,n)- regular open set is (m,n)- semi-regular open when the set is μ_n-closed. The properties of (m,n)-pre open sets, will be investigated in the future.

Keywords: bi-generalized topological spaces, (m,n)-semi-regular open sets, (m,n)-pre open sets.

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IPRC/25/89 Science, Technology, Engineering, Mathematics, and Medicine

A sustainable blockchain-based voting system for corporate-level elections

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Elections are the most important feature of any democracy, whether it is corporate or government. Even in most corporate settings, voting is still done using paper-based mechanisms. These are cumbersome, costly, and not necessarily transparent. They can be error-prone or even tampered with. As businesses are becoming increasingly interested in green and digital solutions, the need for improved processes for voting increases. This paper suggests a blockchain-based voting system specifically designed for corporate-level elections. Running on the Ethereum blockchain and fueled by smart contracts, the suggested system provides end-to-end verifiability, voter anonymity, and result integrity. It guarantees that each vote is cast and counted as exactly desired, without sacrificing voter anonymity. Ethereum's decentralized and tamper-proof ledger records all voting transactions in an open and verifiable manner. Vote casting and tallying are automated through smart contracts such that every vote is tallied exactly as cast without any interference from humans. Voter anonymity is ensured through the concealment of voter identity from the actual vote through pseudonymous addresses or anonymized tokens. Though blockchain-based voting systems have been developed for large-scale public elections, there is no system that has been designed specifically for corporate-level elections. Integrating these large-scale systems into corporate environments is not practical since it is complicated, expensive, and requires a lot of technical skill. Converting such systems would require extensive restructuring of code and architecture to align with corporate election procedures, imposing additional financial and technical loads. This highlights a clear gap in the current voting domain. Therefore, there is a need for a corporate-level voting system, one that is simple, lightweight, and affordable, yet maintains the fundamental attributes of secure and transparent voting. This paper presents a practical and sequential strategy for deploying blockchain to business-level election processes. It illustrates how blockchain can boost trust, efficacy, and involvement in business decision-making spaces.

Keywords: blockchain application, blockchain voting**,** corporate elections, decentralization, smart contracts.

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IPRC/25/128 Science, Technology, Engineering, Mathematics, and Medicine

Screening of polycyclic aromatic hydrocarbon utilization ability of *Trichoderma koningiopsis* isolated from Sapugaskanda industrial zone

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Polycyclic Aromatic Hydrocarbons (PAHs) are environmentally persistent organic pollutants known for their toxicity, carcinogenicity, and long-term stability in ecosystems. The Sapugaskanda industrial zone is heavily impacted by industrial effluents, and serves as a reservoir for several PAHs contaminants. Bioremediation using fungi offers a sustainable and eco-friendly approach for PAH remediation. The present study aimed to isolate and evaluate the PAH-degrading potential of *Trichoderma koningiopsis* from contaminated sites in the Sapugaskanda zone. Water and sediment samples were collected from multiple PAH-contaminated sites within the Sapugaskanda industrial zone. The fungus was identified using morphological characteristics and ITS region DNA sequence analysis, confirmed by comparison with reference sequences in GenBank. Fungal isolation was performed using Potato Dextrose agar (PDA) medium and incubated for 7 days at 27 ± 2 °C. Before the screening step of PAH degradation, the selected fungal strain was starved for three days on Bacto Bushnell-Haas (BBH) medium. Then, starved fungi isolates were reinoculated into BBH medium supplemented individually with 100 ppm of pyrene, phenanthrene, and naphthalene as the sole carbon source and incubated for 10 days at 27 ± 2 °C with triplicates. PAH utilization potential was assessed through mycelial growth rates of fungi. The BBH medium without PAHs was used as the control. The usual growth rate of *Trichoderma koningiopsis* observed on PDA medium is 24.06 ± 0.67 mm day^{-1}, and their growth in PAH added medium is 12.50 ± 0.38 mm day^{-1} on pyrene, 11.86 ± 0.39 mm day^{-1} on phenanthrene, and 12.14 ± 0.67 mm day^{-1} on naphthalene respectively. According to the results, it is revealed that there is a variation in the growth of *Trichoderma koningiopsis* when different hydrocarbons are added to the media. The present study highlights the potential of *T. koningiopsis* for mycoremediation of PAH-contaminated environments, offering an eco-friendly approach to mitigate industrial pollution in tropical ecosystems.

Keywords: fungi, naphthalene, polycyclic aromatic hydrocarbons, pyrene, Trichoderma

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IPRC/25/129 Science, Technology, Engineering, Mathematics, and Medicine

Impact of chemical fertilizer application on the availability of toxic metals for uptake by paddy crops

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The excessive use of chemical fertilizers in agriculture has raised concerns regarding the accumulation of toxic metals in agroecosystems. This study evaluates the effect of inorganic fertilizers on the uptake and distribution of heavy metals/metalloids such as Lead (Pb), Arsenic (As), Cadmium (Cd), and Chromium (Cr) in paddy crops. Two experimental plots were established, where one was treated with inorganic fertilizers while the other was left untreated as the control. A total of 60 samples containing 15 from each category: roots, leaves, grains, and soil were collected. Heavy metals were analyzed using inductively coupled plasma-mass spectrometry and statistical analysis was performed using one-way ANOVA and Tukey's pairwise comparisons. Results revealed a significant difference in Pb, As, Cd and Cr concentrations in crop parts from fertilized plot compared with the control ($p<0.05$). In both plots, the hierarchy of accumulation across plant parts varied as root > leaf > grain. The concentrations of Pb, Cd, As, and Cr in rice grains from the fertilized plot were (4.868 ± 0.195 mg kg^{-1}), (0.0519 ± 0.010 mg kg^{-1}), (0.050 ± 0.025 mg kg^{-1}) and (0.454± 0.020 mg kg^{-1}), respectively, whereas (0.605± 0.135 mg kg^{-1}), (0.046 ± 0.012 mg kg^{-1}), (0.078± 0.013 mg kg^{-1}) and (0.372 ± 0.025 mg kg^{-1}) were in control plot, respectively. The heavy metal/metalloid levels in fertilizer applied samples were notably lower than those observed in the corresponding soil samples. However, a notable increase in heavy metal concentrations was observed in the rice plant tissues from the plot treated with inorganic fertilizers, suggesting that such fertilizers may enhance metal uptake and translocation within the plant system. Further research should focus on investigating the effects of inorganic fertilizer applications on metal solubility and bioavailability, chelation and mobilization processes, and the enhanced root activity and absorption capacity related to the uptake of toxic metals.

Keywords: accumulation, fertilizer, heavy metals, paddy soil, rice

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IPRC/25/130 Science, Technology, Engineering, Mathematics, and Medicine

Assessment of antioxidant, antibacterial, and toxicity profiles of the Sri Lankan young tall coconut (*Cocos nucifera L.)* variety for its potential as a future therapeutic agent in wound healing

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The extract of the Sri Lankan young Tall coconut (*Cocos nucifera L.*) has drawn attention as a promising therapeutic agent for wound healing, attributed to its rich bioactive profile. This study assessed its antioxidant, antibacterial, and toxicity profiles to substantiate its potential applications in clinical wound management. Antioxidant activity was quantified using 2,2-diphenyl-1-picrylhydrazyl (DPPH) and Ferric Reducing Antioxidant Power (FRAP) assays. The DPPH assay demonstrated exceptional antioxidant potency for ascorbic acid (IC_{50} = 13.05 ± 0.33 μgmL^{-1}), significantly surpassing the coconut extract (IC_{50} = 308.93 ± 1.82 μgmL^{-1}, $P < 0.05$), which exhibited moderate reducing power (1.16 μmol $FeSO_4 dm^{-3}$) in the FRAP assay. Antibacterial efficacy was evaluated using the disk diffusion method against *Staphylococcus aureus* and *Escherichia coli*. The extract showed dose-dependent inhibition of *S. aureus*, with inhibition zones of 17.33 ± 4.36 mm, 12.36 ± 2.68 mm, and 7.48 ± 5.40 mm at 1000 mg dm^{-3}, 500 mg dm^{-3} and 50 mg dm^{-3}, respectively, nearing vancomycin's CLSI standard efficacy. Conversely, no inhibition was observed against *E. coli* at concentrations ranging from 50 to 1000 mg dm^{-3}, suggesting limited broad-spectrum antimicrobial activity. Toxicity was evaluated using the brine shrimp lethality test (BSLT), yielding an LC_{50} of 116.97 mgL^{-1}, indicative of moderate toxicity and supporting safe therapeutic use at controlled doses. The zebra fish assay further confirmed low toxicity, with LC_{50} values decreasing from 2364.7 μg mL^{-1} at 48 hours post-fertilization (hpf) to 958.3 μgmL^{-1} at 96 hpf, underscoring its safety in vertebrate models. These results emphasize the extract's moderate antioxidant properties, notable dose-dependent antibacterial activity against *Staphylococcus aureus* and significant safety profile with an LC_{50} of 116.97 μgmL^{-1}, positioning it as a viable candidate for wound healing applications at optimized doses below this toxicity threshold. Future studies should focus on isolating active compounds, enhancing antibacterial efficacy, and validating clinical outcomes to advance their therapeutic potential.

Keywords: antibacterial efficacy, antioxidant activity, Sri Lankan young Tall coconut, toxicity assessment, wound healing

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IPRC/25/133 Science, Technology, Engineering, Mathematics, and Medicine

Morpho-molecular characterization and cultivation potential of the Wild Edible Mushroom *Lentinus squarrosulus* from the Wet Zone of Sri Lanka

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Lentinus squarrosulus, a wild edible mushroom naturally occurring in wet zone forests, is valued for its meaty texture and ethnomedicinal properties. This study aimed to evaluate its domestication potential by analyzing its morphological, molecular, and cultivation characteristics. Field surveys across selected wet zone forest sites yielded 20 specimens, which were assessed for key macro- and micromorphological features. Visual observations were used to document traits such as cap and lamella coloration, and the size of the stipe. The spore morphology was examined in 30 spore samples using a light microscope (ECLIPSE E100LED MVR, China) under 40x magnification after staining with Congo red. Mycelial growth rate, density, and morphology were also observed. Molecular identification was performed through amplification and sequencing of the internal transcribed spacer (ITS) region of ribosomal DNA, with phylogenetic analyses confirming the identity of the collected isolates. Additionally, mycelial growth was evaluated on lignocellulosic substrates (such as rubber saw dust, fruit waste, tea waste, and grass straw) at room temperature (28 ^{0}C) to assess colonization potential. Following the morphological characterizations, including basidiocarps whitish to greyish with notable squamulose on the surface, the cap was lamellate type, lamella deeply decurrent, stipe 2-5 cm height and 2-5 mm in diameter and sometimes with a subbulbous base. Spores were whitish, cylindrical, and the size ranged from 5.5–6.7 µm in length and 1.5–2.5 µm in width. This strain's mycelial growth generally had a longitudinally radial morphology with circular rings, later turning brown and thickening with prolonged incubation. The collected isolate was positioned within a well-supported clade of *L. squarrosulus* with 68% bootstrap support by ITS-based phylogeny, suggesting a close genetic relationship with other Asian strains. Favorable mycelial colonization was recorded on rubber sawdust supplemented with rice bran. These results demonstrate that *L. squarrosulus* is a promising candidate for low-cost mushroom farming in Sri Lanka.

Keywords: Basidiomycetes, *Lentinus* cultivation, morpho-molecular characterization

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IPRC/25/138 Science, Technology, Engineering, Mathematics, and Medicine

Investigating air quality in Colombo: A comparative study of web-based applications for air quality index prediction and forecasting

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This study addresses the critical challenge of escalating urban air pollution in Colombo, Sri Lanka, by bridging a significant gap in digitalized, accessible, integrated, and predictive air quality information. Unfortunately, the significant development in Colombo has led to a considerable deterioration of its air quality, evident in consistently high pollutant concentrations. It aims to achieve this through a dual approach: designing and comparing two novel web applications for *particulate matter* $PM_{2.5}$ and PM_{10} derived air quality index *(AQI)* forecasting and prediction and conducting a comprehensive analysis of Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2). The methodology involved developing "Web Application 1", utilizes a machine learning (random forest regression) model for *AQI* prediction by user-inputted $PM_{2.5}$ and PM_{10} concentrations, and web application 2", integrates a *Time Series (SARIMAX)* model for forecasting for future periods for average user-inputted $PM_{2.5}$ and PM_{10} concentrations, using *"Shiny"* application in *R.* The data was collected through a secondary data source, which is the National Building Research Organization-Sri Lanka, and from March 2020 to December 2024, daily data of particulate matter and NO_2, and SO_2 data concentrations from October 2012 to December 2019 for several locations, such as Gangarama Temple, Fort railway station, Kelaniya, Borella police etc. in the Colombo area, were used in the study. The researcher conducted spatial hotspot analysis, identified the relationships using multiple linear regression models, and further developed a decision tree classification model for categorizing AQI into health categories for NO_2 and SO_2. Key findings reveal that both web applications effectively provide actionable insights, offering immediate, real-time awareness and crucial forward-looking forecasts, with an R2 of 0.997 for the random forest model and a 1.68 low RMSE value for the SARIMAX model, providing zero-centered residuals, indicating high accuracy. $PM_{2.5}$ was identified as a higher contributor to the Overall AQI compared to PM_{10}, and the correlation between PM2.5 and PM10 is +0.88. High positive correlations were observed for NO_2 and SO_2 concentrations with the Overall AQI. The correlation between NO_2 and SO_2 is +0.18 significantly very low. The spatial hotspot analysis identified Maradana railway station as the highest polluted area for both NO_2 (average 67.41μgm^{-3}) and SO_2 (average 58.67μgm^{-3}). The decision tree model translates complex pollutant levels into categories with 99.4% accuracy.

Keywords: Air quality in Colombo, decision tree classification, machine learning, shiny web application, time series regression

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IPRC/25/142 Science, Technology, Engineering, Mathematics, and Medicine

Essential trace elements; zinc (Zn), selenium (Se) & manganese (Mn) in commonly consumed Sri Lankan commercial rice (*Oryza sativa* L.)

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Rice (*Oryza sativa* L.), the dietary staple of Sri Lankans, is a known source of essential trace elements (ETEs) which are an integral part of human metabolism for health and well-being. Ten widely consumed husked rice varieties, varying by processing type, origin, and pericarp colour, were collected from dedicated economic centers in Sri Lanka. Lyophilized grain powders from twenty-four analytical composites were digested and profiled using inductively coupled plasma mass spectrometry (ICP-MS). Results were expressed as milligrams per kilogram of raw rice (mg kg^{-1}) on wet weight basis. The mean ±SD concentrations of Zn, Se, and Mn were 30.12±6.53, 0.05±0.01, and 12.90 ±3.68 mg kg^{-1}, respectively. Red rice varieties had significantly higher concentrations of all ETEs (student-t test, $p<0.05$, two-tailed) compared to white varieties. Cumulative ETE levels followed the order: traditional (53.06 ±3.39 mg Kg^{-1}) > improved (42.64±7.85 mg Kg^{-1}) > imported (27.22±1.12 mg Kg^{-1}), with statistically significant inter-category differences (one-way ANOVA, $p<0.05$). Traditional varieties contained significantly higher Se and Mn levels than improved varieties (student-t test, $p<0.05$, two-tailed). In comparison to non-parboiled rice varieties (Zn: 25.11±5.49; Se:0.04±0.01; Mn:10.36±1.54 mg Kg^{-1}), parboiled rice varieties exhibited a considerably higher accumulation of ETEs (Zn:33.47±4.87; Se:0.05 ±0.01; Mn:14.60 ±3.74 mg Kg^{-1}) (student-t test, $p<0.05$, two-tailed). When comparing the ETEs levels within the improved rice types, the Zn and Mn levels were higher in parboiled *Nadu* (student-t test, $p<0.05$, two-tailed) and Samba varieties (student-t test, $p>0.05$) than in Kekulu rice, while Se levels were similar (one-way ANOVA, $p<0.05$). Zn and Se (Pearson correlation statistic, $r=0.54$, $p<0.05$, two-tailed), Zn and Mn (Pearson correlation statistic $r=0.60$, $p<0.05$, two-tailed), and Se and Mn (Pearson correlation statistic $r=0.81$, $p<0.001$, two-tailed) all showed significant positive relationships suggesting possible synergistic bioaccumulations. These findings indicate that Sri Lankan rice is a valuable source of ETEs. Compared to white pericarp non-parboiled Kekulu rice, red pericarp traditional parboiled rice types might provide a clear nutritional advantage in terms of trace element intake.

Keywords: essential elements, beneficial elements, rice, Sri Lanka, commercial rice

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Refined stellar modelling and V-band photometric calibration of the eclipsing δ Scuti binary system KIC 6629588

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Eclipsing binary systems with Delta (δ) Scuti-type pulsating components are valuable for studying both binary dynamics and stellar pulsations. To enable accurate analysis of these two fields, the disentanglement of the binary nature from the observed light curve must be performed successfully. Photometric data from the Kepler mission on the detached eclipsing binary system KIC 6629588, which contains a δ Scuti component, were used in this study. The binary modeling was carried out using the Wilson-Devinney (WD) program, demonstrating the application of the Differential Correction (DC2015) process within the WD program framework. This approach represents an improvement over previous studies that primarily employed only the Light Curve (LC2015) modelling process in the WD program. The Levenberg-Marquardt algorithm was employed in the DC2015 for parameter refinement. The refined model provides highly accurate stellar parameters, yielding effective temperatures of the primary and secondary stars of 7153.11 ± 1.28 K and 4438.30 ± 0.50 K respectively. The derived mass ratio is 0.77 ± 0.00, inclination angle is 68.37 ± 0.01 degrees and the primary star luminosity is 9.72 ± 0.00 $L_{\odot}$. The DC2015 refinement significantly improves the disentanglement of the binary nature. In addition, this study provides the first identification of the Visual (V) band magnitude of KIC 6629588 as 14.11 ± 0.00 mag, by applying Gaia photometric data to polynomial transformations for the Johnson-Cousins system. The analysis was also extended to estimate the absolute magnitude in the V band as 2.32 mag. This combined study of WD modelling and photometric calibration offers a refined and comprehensive interpretation of the eclipsing binary system KIC 6629588.

Keywords: Delta Scuti stars, differential correction, KIC 6629588, visual band magnitude, WD modelling

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IPRC/25/156 Science, Technology, Engineering, Mathematics, and Medicine

Oxidative stress modulation and macromolecular protection by selected Sri Lankan ethnomedical plants

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Oxidative stress arises from an imbalance between reactive oxygen species and endogenous antioxidant defenses, leading to damage of cellular macromolecules. This damage plays a key role in the pathogenesis of chronic diseases such as neurodegenerative, cardiovascular, and metabolic disorders. Mitigation of oxidative stress and preservation of macromolecular integrity have emerged as critical therapeutic strategies, particularly by using natural compounds. This study investigated the antioxidant activity and macromolecular protective potential of ethanol, ethyl acetate, and hexane extracts from four Sri Lankan ethnomedicinal plants: *Laggera alata*, *Aporosa lindleyana*, *Euphorbia thymifolia*, and *Euphorbia hirta*, prepared using cold solvent extraction. Extracts rich in phytochemicals were identified based on their antioxidant capacity using DPPH radical scavenging and ferric-reducing antioxidant power (FRAP) assays. Selected extracts were further evaluated for their ability to inhibit oxidative damage to lipids and proteins using TBARS and 2,4-dinitrophenylhydrazine assays, respectively, with butylated hydroxytoluene (BHT) as the reference standard. The ethanolic extract of *A. lindleyana* and *E. thymifolia* exhibited potent antioxidant activity with IC_{50} values of 4.62 ± 0.25 and 15.94 µg/mL, respectively. All ethanolic extracts showed a dose-dependent antioxidant effect in the FRAP assay, with the *E. thymifolia* extract demonstrating the highest activity. At a concentration of 25 µg/mL of *E. thymifolia* extract inhibited 27.75 ± 0.01% of lipid peroxidation and protein oxidation by 37.62 ± 0.02% ($P > 0.05$ compared to BHT). Hexane extracts from all the tested plants exhibited no measurable antioxidant activity. The extract of *L. alata* and *E. hirta* represented significantly weaker ($P < 0.05$) antioxidant and protective profiles across all assays. These findings support the traditional use of *A. lindleyana* and *E. thymifolia* in herbal medicine and highlight their potential in mitigating oxidative stress and macromolecular damage. Further phytochemical and mechanistic investigations are needed to identify the bioactive constituents responsible for the reported effects.

Keywords: *Aporosa lindleyana, Euphorbia hirta, Euphorbia thymifolia, Laggera alata*, Oxidative stress

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IPRC/25/165 Science, Technology, Engineering, Mathematics, and Medicine

Investigating phytochemical composition in abiotic stress responses of *S. androgynous* leaf extracts; analysis of anti-diabetic, anti-bacterial potential

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Abiotic stressors are unfavorable environmental conditions which hinder crop growth, causing alterations to their metabolome for survival. When grown in unfavorable conditions, crops may have altered effects when ingested. *Sauropus androgynous*, locally known as "Japan *batu*", is a tropical leafy shrub with ethnobotanical uses against diabetes, alopecia and agalactia, owing to its rich phytochemical composition. In this study, *S. androgynous* was subjected to four common abiotic stressors – high salinity, through the addition of $NaCl_{(aq)}$, nutrient-deficiency simulated in autoclaved sand, waterlogging, and drought using PEG 4000, maintained over 14 days. Aqueous leaf-extracts were used to qualitatively test alkaloids, flavonoids, saponins, tannins, coumarins, phenols, cardiac glycosides, terpenoids and steroids. Quantitative analysis comprised total phenolic content (TPC, Folin-Ciocalteu's method), total flavonoid content (TFC, $AlCl_3$ method), total antioxidant capacity (TAC, phosphomolybdenum method) and total protein content (TPrC, Lowry Assay). A methanolic control-leaf extract was prepared to test for pancreatic α-amylase inhibition and antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. Results showed absence of tannins, phenols and cardiac glycosides under salt, water and nutrient stress. Drought plants showed elevated TPC of 40.26 GAE/mg, TAC of 23.51 AAE/mg, and TFC of 22.96 QE/mg, while nutrient-deficiency showed highest TPrC of 203.81 BSAE/mg. The overall flavonoid content was relatively lower compared to other studies with absence across qualitative tests, reflecting a possible regional difference in the plant metabolome. Anti-glycemic activity of a 170 mg/mL sample reflected that of 40-60 µg/mL of acarbose activity, with anti-microbial effect exhibited on both bacterial species, with inhibition zones observed at 3 mm and 5 mm, respectively, suggesting pharmacological uses. Thus, the metabolome of *S. androgynous* is altered in response to abiotic factors.

Keywords: Abiotic stress, aqueous extract, methanolic extract, phytochemical composition, *Sauropus androgynous*.

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Impact of heat transfer through porous media in enhanced oil recovery

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The global energy landscape is evolving, with an increased emphasis on improving hydrocarbon resource recovery while reducing environmental effects. Enhanced oil recovery (EOR) methods are critical in increasing oil extraction from reservoirs. Thermal flooding is one of these strategies that has shown promise in enhancing recovery rates, particularly in heavy oil reservoirs. However, the impact of gravitational factors on thermal flooding efficiency is still being researched and explored. This study investigates the effectiveness of hot water and hot carbon dioxide (CO_2) injection in EOR using computational simulations conducted in COMSOL Multiphysics 6.3. The model was implemented using Darcy's Law, transport of diluted species in homogeneous porous media, and heat transfer in porous media to capture the coupled fluid flow, thermal effects, and species transport. Comparative simulations were carried out to analyze the displacement behavior of oil under both injection strategies. The results reveal that hot water injections produce a more stable displacement front with broader sweep efficiency and minimal bypassing, leading to higher oil recovery at early stage. In addition, hot CO_2 injection exhibits a high-concentration zones due to viscous fingering and flow instability, which result in reduced sweep efficiency despite strong solvent and thermal effects. The highest peak concentration was observed in the hot CO_2 case and poor volumetric coverage and significant channeling were present. Normal water injection, while more stable than CO_2, lacked the thermal advantage of hot injection. Overall, hot water injections yielded the most uniform displacement and effective oil recovery within the simulated period. Further, incorporating gravitational effects for a non-horizontal reservoir domain inclined toward the negative x-direction shows potential to moderate and improve oil recovery. The results suggest that reservoir geometry and heat transferring can be jointly considered for optimizing EOR outcomes.

Keywords: Darcy's law, heat transfer, homogeneous porous medium, hot liquid and gas, thermal viscous fingering

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Synergistic biocontrol and induced resistance in rice against bacterial leaf blight by *Pseudomonas chlororaphis* and *Flavobacterium ginsenosidimutans* YTB16

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Bacterial leaf blight (BLB), caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) is capable of causing up to 50% yield losses. This study aimed to isolate and characterize rhizosphere bacteria with antagonistic activity against *Xoo*. Rhizosphere soil samples were collected from healthy rice plants in Anhui province, China, and 96 bacterial cultures were isolated using beef peptone agar. Amplified ribosomal DNA restriction analysis (ARDRA) grouped these isolates into 17 clusters, and 16S rRNA gene sequencing identified them as members of 11 genera. Two strains: *Flavobacterium ginsenosidimutans* YTB16 and *Pseudomonas chlororaphis* JTB29 were selected for their strong biocontrol potential. *In vitro* and *in vivo* assays, conducted with three independent biological replicates and repeated twice, demonstrated that both strains individually reduced BLB incidence by over 60%, while their consortium achieved 75% suppression. Disease incidence was determined by scoring the symptomatic leaf area, and the percentage reduction was calculated relative to the positive control. Data were statistically analyzed using one-way ANOVA followed by Tukey's HSD test ($p < 0.05$). In pot experiments, consortium application showed significantly ($P<0.05$) increased chlorophyll (~2.26-fold), carotenoids (~2.06-fold), plant height (~2.1-fold), dry weight (~2.11-fold), and seed yield (~21-fold) compared to the positive control. It also enhanced total phenolic content (~1.95-fold) and elevated the activities of peroxidase (~2.4-fold), phenylalanine ammonia-lyase (~2.2-fold), and polyphenol oxidase (~2.3-fold) in rice plants challenged with *Xoo*, indicating the activation of systemic defense responses. Functional assays further revealed that *P. chlororaphis* produced cellulase, contributing to pathogen cell wall degradation, while *F. ginsenosidimutans* synthesized salicylic acid, hydrogen cyanide, and siderophores; key metabolites associated with induced resistance, pathogen inhibition, and iron competition. These findings highlight the potential of *Pseudomonas* and *Flavobacterium* consortia as stable, versatile, and eco-friendly biocontrol agents for sustainable management of BLB in rice.

Keywords: bacterial leaf blight, *Flavobacterium*, induced resistance, *Pseudomonas*, synthetic consortium

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IPRC/25/145 Science, Technology, Engineering, Mathematics, and Medicine

Sustainable crop protection using green-synthesized metal and metal oxide nanoparticles against *Fusarium oxysporum*

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In this study silver, copper oxide and iron oxide nanoparticles were synthesized using *Melia azedarach* leaf extract. The synthesized nanoparticles were checked for their antifungal potential both *in vitro* and *in vivo* against *Fusarium oxysporum* the causal agent of fungal wilt. Food poisoning assay with various concentrations of synthesized nanoparticles, showed reduction in fungal growth up to 97%. When visualized under electron microscope, the treated fungal mycelium showed distortion in their structure with stacking, rifts and depressions. Highest tested concentration of nanoparticles resulted in complete cleavage of DNA when run on agarose gel electrophoresis. A control sample, DNA from samples without nanoparticles was included that showed intact DNA. Whereas DNA from samples treated with nanoparticles showed disappearance of intact DNA bands. Smearing and faint bands in nanoparticle treated samples confirmed DNA fragmentation. DNA purity and quality was checked by absorbance before running on gel. When checked under greenhouse conditions, these synthesized nanoparticles significantly reduced disease incidence of fusarium wilt in tomato. Green house experiment consisted of five replicates of each treatment. Studies on whole metabolomics of treated plants showed increment in defense related enzymes and total phenolics. Each type of nanoparticles was further characterized to get information about wavelength range, functional nature, crystallographic structure, size, shape and stability. Using X-Ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analysis, spherical shaped nanoparticles were documented that ranged between 10 - 50 nm. The potential of these nanoparticles to control fusarium wilt was reconfirmed in field conditions. Further trials showed no visible sign of toxicity on crop yield and productivity. The metal concentrations when checked in edible parts were found in permissible limits. The studies confirmed potential of green synthesized nanoparticles to be used as crop protectants as part of sustainable agriculture.

Keywords: Fusarium wilt, metal nanoparticles, nanotechnology, phytopathogen, sustainable agriculture

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IPRC/25/190 Science, Technology, Engineering, Mathematics, and Medicine

A sustainable and eco-friendly approach for fulfilling the nitrogen fertilizer requirement in the agricultural Sector

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Most South Asian countries heavily depend on agricultural-based economies. The government bears a significant financial burden annually on imported nitrogen-based fertilizers. This places a significant strain on the country's economy. This study explores the feasibility of fulfilling the local Nitrogen fertilizer requirement through an in-situ synthesis of nitrogen fertilizer from atmospheric air by using plasma energy generated through renewable sources. A laboratory-scale experiment was conducted using a 250W DC plasma generator to convert atmospheric air into nitric acid. In the first stage, atmospheric nitrogen was oxidized into a mixture of NOx gases using plasma energy. NOx were then bubbled through a series of gas-wash bottles containing deionized water, facilitating the formation of nitrate and nitrite ions. After 15 hours of processing, a 500 ml synthesised sample yielded nitrate and nitrite concentrations of 7000±17 ppm and 460±4ppm (n=3) , respectively as measured using ion chromatography. Further studies were conducted to determine the fixation efficiencies using different fixing media. For a 0.5-hour period, the results showed nitrate and nitrite concentrations of 11.21±0.08 ppm and 0.77±0.01 ppm (n=3) with only water as the fixing medium, 17.45 ppm and 10.04 ppm in the presence of Ozone, and 20.40 ppm and 35.50 ppm in the presence of ammonia in the medium. To enhance the yield, further a wet tissue trap was incorporated for the NOx synthesis process, yielding a 60 % increase in the synthesized nitric acid. This system has been designed to operate using solar energy, which is abundantly available in equatorial regions such as Sri Lanka. This in-situ method utilizes only atmospheric air and water as the raw material, and generates no hazardous waste or by-products. The approach offers a sustainable and environmentally friendly alternative for nitrogen fertilizer production, making it a promising solution for addressing agricultural needs in a cost-effective and eco-conscious manner.

Keywords: Atmospheric nitrogen fixation; Plasma-assisted synthesis; Sustainable nitrogen fertilizer; Renewable energy applications; Eco-friendly agriculture

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