Advancing Science and Technology Research for a Better Future

Faculty of Science
University of Ruhuna

RUSTCON 2025

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Abstracts and Plenary Lectures

RISTCON 2025

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Editorial Note

Thanks to all the authors, we have received a high number of abstracts in diverse disciplines under science and technology for RISTCON-2025. First, all of the initial submissions were screened for novelty and plagiarism. We then used a double-blind review, with each blind (extended) abstract sent to three experts in the relevant field. The final decision of the submitted abstract was made by the editorial board by considering the decisions and comments made by the reviewers. We believe that this unbiased review process has ensured a high quality and standard in the publication of proceedings.

However, the responsibility for the content in each publication remains with the respective authors. No part of this serial publication will be reproduced in any form. When citing the published abstracts, this serial publication can be referred to as 'Proceedings of the 12th Ruhuna International Science and Technology Conference - 2025, Faculty of Science, University of Ruhuna, Matara, Sri Lanka'.

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RISTCON-2025

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Message from the Competent Authority, University of Ruhuna

It is with immense pride and great enthusiasm that I extend my warmest greetings to all participants of the 12th Ruhuna International Science and Technology Conference (RISTCON 2025). This year, we come together under the inspiring theme, "Advancing Science and Technology Research for a Better Future". This theme underscores the importance of our shared responsibility to foster innovation and harness scientific and technological advancements for the betterment of society, as we collectively strive to address the challenges facing our world today.

RISTCON 2025 provides a unique platform for the exchange of ideas, the sharing of groundbreaking research, and the building of collaborations among academics, researchers, and industry leaders. The work presented here reflects our dedication to finding innovative solutions to key global issues such as public health, environmental sustainability, and technological advancement.

The University of Ruhuna remains committed to supporting initiatives that promote academic excellence, interdisciplinary research, and collaborative partnerships. I would like to extend my heartfelt gratitude to the organizing committee, the Faculty of Science, and all those whose tireless efforts have made RISTCON 2025 possible. Your contributions have ensured the success of this conference, and for that, we are deeply appreciative.

I encourage each participant to engage actively in discussions, share their valuable insights, and forge new collaborations that will drive innovation and create lasting positive change. May this conference serve as a catalyst for transformative ideas and the cultivation of partnerships that will endure and flourish in the years ahead.

Wishing you all a highly productive and rewarding conference, and may this event serve as a significant step towards a brighter, more sustainable future.

Senior Professor R. M. U. S. K. Rathnayaka
Competent Authority
University of Ruhuna

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Message from the Dean, Faculty of Science, University of Ruhuna

It is my great pleasure to deliver this message to the proceedings of the RISTCON 2025 - the Ruhuna International Science and Technology Conference. This year's theme, Advancing Science and Technology Research for a Better Future, embodies our collective commitment to harnessing the power of research and innovation to address the complex challenges of our time.

In today's world, science and technology serve as transformative forces that drive progress, improve quality of life, and shape sustainable futures. The theme of the conference underscores the critical role of interdisciplinary collaboration in shaping sustainable solutions to global challenges. From combating climate change to enhancing healthcare, from revolutionizing energy systems to unlocking the potential of artificial intelligence, the scope of scientific inquiry and technological innovation knows no bounds.

To the authors whose work has been accepted for presentation and publication, congratulations on your remarkable achievements. Your research exemplifies the ingenuity and perseverance that define the scientific community. You inspire us to continue striving for excellence and to seek answers to some of the most pressing questions facing humanity.

I extend my heartfelt thanks to distinguished guest speakers for sharing their insights, experiences, and groundbreaking research. Your contributions not only enhance the depth and quality of this conference but also inspire us to think creatively and collaboratively in our pursuit of solutions for a better future. To our esteemed reviewers, your role in ensuring the integrity and rigor of the research presented here is deeply valued. A special thanks goes to the organizing committee for their exceptional dedication and meticulous planning in making RISTCON 2025 a reality. Your hard work ensures this conference serves as a vibrant hub for knowledge exchange, collaboration, and inspiration.

As we gather to explore the cutting-edge of scientific and technological innovation, I encourage all participants to immerse themselves in the discussions, engage with peers from diverse fields, and seize the opportunity to form lasting partnerships. Together, let us contribute to a future where science and technology address societal challenges and foster global well-being.

Wishing you all an enriching and successful conference!

Professor (Mrs) D.H.N. Munasinghe
Dean
Faculty of Science

Message from the Chairperson – RISTCON 2025

It is my great pleasure to welcome you all to the 12th Ruhuna International Science and Technology Conference (RISTCON 2025), scheduled for January 22, 2025, under the theme "Advancing Science and Technology Research for a Better Future!". RISTCON has become a leading platform for scholarly exchange, uniting researchers and thought leaders worldwide to discuss groundbreaking developments in various fields.

The success of RISTCON is largely due to the guidance and support of our esteemed academic leaders, including the newly appointed Competent Authority of the University of Ruhuna, Senior Professor R. M. U. S. K. Rathnayaka, and the Dean of the Faculty of Science, Professor D. H. N. Munasinghe. Their leadership, combined with the dedication of the academic staff, has helped RISTCON grow into the influential conference it is today, driving innovation in science and technology.

I would like to express my profound gratitude to our distinguished Keynote Speaker, Professor Archana Sharma, Senior Scientist at CERN, who has traveled from Geneva to share her valuable insights. I also extend my thanks to our esteemed Plenary Speakers, Professor W. A. Priyanka P. De Silva, Professor of Zoology at the University of Peradeniya, Sri Lanka, and Professor Channa De Silva, Professor of Chemistry at Western Carolina University, USA, for their contributions, which will undoubtedly inspire and enhance our discussions.

This year, we received 191 abstracts, reflecting the global significance of RISTCON. After a thorough peer-review process, 146 research communications have been selected for presentation. These abstracts will be published in the conference proceedings, contributing to the growing body of knowledge across diverse fields such as Science, Engineering, Medicine, Health Sciences, Agriculture, Fisheries, and Natural Sciences. I sincerely thank the Editorial and Advisory Board members, as well as the reviewers, for their invaluable efforts in ensuring the success of this event.

A special note of appreciation is extended to our sponsors Sanasa Development Bank, Matara; Sri Lanka Insurance; and Bank of Ceylon for their generous financial support, which has been instrumental in the success of RISTCON 2025. I also wish to convey my heartfelt gratitude to all members of the Faculty of Science for their

unwavering support and invaluable contributions, which have been integral to the realization of this event.

I look forward to the fruitful discussions and collaborations that RISTCON 2025 will foster. Together, we can continue advancing science and technology for a better future.

Dr. A.W.L. Pubudu Thilan
Chairperson – RISTCON 2025

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Empowering the Future: Research and Innovation for Global Impact

Professor Archana Sharma

Physicist and Senior scientist
European Organization for Nuclear Research (CERN)
Geneva
Switzerland

The talk showcases the transformative role of CERN in advancing fundamental physics and its wide-reaching societal impact. She delves into the mysteries of the universe, such as dark matter, dark energy, and the scarcity of antimatter, while exploring how CERN's research addresses these profound questions. Key milestones, like the discovery of the Higgs boson in 2012, underline the importance of particle physics in explaining why fundamental particles have mass. Prof. Sharma highlights her significant contributions to detector technology, particularly in the Compact Muon Solenoid (CMS) experiment. She elaborates on her work with Gas Electron Multipliers (GEMs), a cutting-edge technology she championed and implemented at CERN. GEMs improve the precision of muon detection and tracking, enabling the CMS experiment to achieve more accurate measurements of high-energy particle collisions. This innovation, initially considered ambitious in 2009, became a reality with installations in 2019, solidifying its role in Phase II upgrades of the LHC. CERN's Large Hadron Collider (LHC) serves as the central focus, described as a 27- kilometer-long scientific marvel designed to recreate conditions from a fraction of a second after the Big Bang. Detectors like CMS, ATLAS, ALICE, and LHCb act as threedimensional cameras, capturing up to 40 million particle collisions per second to study new particles and forces. This work relies on the

collaborative eZorts of thousands of scientists, engineers, and technicians worldwide, including Prof. Sharma's outreach and capacity-building eZorts in

Sri Lanka. In collaboration with Sri Lanka, Prof. Sharma has contributed to knowledge sharing and fostering young talent, emphasizing the importance of diversity in scientific progress. Her work bridges the gap between cutting-edge research and global participation, inspiring students from diverse backgrounds to contribute to CERN's mission. Beyond fundamental physics, the presentation underscores CERN’s technological innovations, from the invention of the World Wide Web to applications in medical imaging and cancer therapy. Prof. Sharma emphasizes proton therapy's potential, showcasing partnerships like CERN-CNAO, which leverage accelerator technology to treat complex cancers with precision and aZordability. Looking ahead, Prof. Sharma envisions a future where CERN's advancements continue to unravel the universe's mysteries while improving millions of lives, reinforcing the critical intersection of curiosity-driven research and global societal benefit. Her work embodies the power of science to transcend boundaries and inspire the next generation of researchers and innovators.

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Microwave-Assisted Preparation of Lanthanide-Based Nanoparticles for Luminescent and Biomedical Applications

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Nanotechnology, defined as the science and engineering of materials at dimensions ranging from approximately one to one hundred nanometers, holds vast potential for future applications across diverse fields, particularly in biomedical sciences. Its applications promise advancements in cellular imaging, diagnostic techniques, drug delivery systems, cancer treatment, antimicrobial therapies, and gene therapy. Ancient historical findings have even shown evidence of early uses of nanotechnology. Current developments in this field extend to drug delivery, biomedical imaging, theragnostic and antimicrobial applications, as well as applications in the paint, agriculture, food, polymer, electronic, and environmental industries.

Among various nanoparticle systems, lanthanide-based nanoparticles are distinguished by their exceptional luminescent properties, such as sharp and narrow emission bands, extended luminescent lifetimes, large Stokes shifts, minimal photobleaching, and tunable emission wavelengths. Due to these unique optical qualities, lanthanide-based nanomaterials have applications in advanced photonic devices, biological imaging agents, security printing, and sensory devices. This study emphasizes the synthesis, characterization, and biomedical applications of lanthanide-based nanoparticles, with a focus on their microwave-assisted preparation.

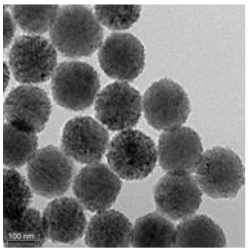
Microwave synthesis provides several advantages over conventional heating in chemical synthesis, including rapid and uniform heating, shorter reaction times,

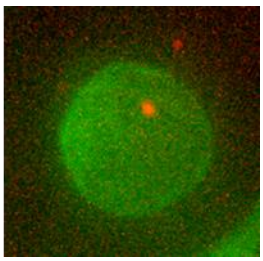
higher efficiency, controlled heating, enhanced energy efficiency, and improved reproducibility.

Among lanthanide-based nanoparticles, calcium fluoride and zinc oxide have garnered significant interest due to their low toxicity, biocompatibility, and stability, making them ideal for biomedical applications. This work presents a microwave-assisted synthesis method for metal-based nanoparticles, yielding products with high reproducibility, colloidal stability, and monodispersity.

Powder X-ray diffraction studies confirm the crystallinity of the nanoparticles, with europium doping levels causing minimal changes to crystal structures. Transmission electron microscopy images confirm the production of highly monodispersed, nearly spherical nanoparticles. These nanoparticles exhibit europium (III)-based luminescence at 615 nm when excited at 340 nm, with a full-width at half maximum of 15 nm. Imaging of HEK293 cells using these nanoparticles demonstrates their potential in cellular imaging applications.

Furthermore, zinc oxide nanoparticles show antimicrobial activity against three bacterial species, evaluated through agar diffusion and minimum inhibitory concentration assays. Surface functionalization of these nanoparticles enhances their promise for biomedical applications, paving the way for novel diagnostic and therapeutic strategies in nanomedicine.





Keywords: Nanoparticles, biomedical imaging, antimicrobial, luminescence, lanthanides

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Zoonotic Diseases and Vector-Host Dynamics: Key Research Priorities and Control Strategies for Public Health in Tropical Regions

Professor W. A. Priyanka P. De Silva
Department of Zoology, Faculty of Science, University of Peradeniya, Sri Lanka

In tropical regions like Sri Lanka, zoonotic diseases spread by insect vectors, such as mosquitoes, sandflies, and ticks, remain a major public health threat. The transmission of pathogens from animals to humans is driven by complex interactions among vectors, hosts, and environmental factors unique to these regions. Addressing these diseases effectively requires understanding these dynamics and implementing sustainable control strategies that protect both human health and the environment. This discussion highlights key research priorities and innovative strategies for managing zoonotic diseases, with a focus on integrating eco-friendly and genetic approaches within a comprehensive vector control framework.

A primary research priority is understanding wildlife pathogens and emerging zoonoses. Tropical ecosystems' biodiversity facilitates pathogen transmission between wildlife, livestock, and human populations, creating reservoirs that may lead to new disease outbreaks. Monitoring pathogens in wildlife populations and assessing conditions under which they spill over into humans are essential steps in predicting and preventing these outbreaks. Diseases such as leishmaniasis, malaria, filariasis and dengue, transmitted by sandflies and mosquitoes, are prominent in these regions and demand ongoing surveillance and study.

Another crucial area is understanding the sensory ecology and host-seeking behavior of vectors. Vectors rely on sensory cues, including olfactory, visual, and thermal signals, to locate hosts. By understanding these mechanisms, researchers can identify opportunities to disrupt vector-host interactions and

reduce disease transmission. For example, specific attractants or repellents can be designed to interfere with vector attraction, thereby reducing vector contact with humans. Combating insecticide resistance also remains a critical priority, as resistance mechanisms, including kdr mutations and elevated enzyme levels in disease causing vectors, make traditional insecticides less effective. In response, researchers are turning to eco-friendly alternatives such as plant-based deterrents and microbial agents. Compounds derived from plants like neem and citronella have shown strong larvicidal effects, offering a natural and less environmentally harmful alternative. Green-synthesized nanoparticles, derived from plant extracts, further offer effective mosquito control with a minimal ecological footprint. In microbial control, bacteria such as Wolbachia and bio-larvicides such as Bacillus thuringiensis present promising avenues for reducing disease transmission. Wolbachia bacteria, introduced into mosquito populations, can hinder pathogen transmission by altering the mosquito's physiology.

These approaches converge within the Integrated Vector Management (IVM) framework, which combines eco-friendly, microbial, and genetic tools in a holistic strategy for vector control. In regions where the ecological impact of control measures must be considered, IVM balances public health needs with environmental protection.

The use of microbial agents, plant-based deterrents, and genetic monitoring for resistance offers a multi-faceted, sustainable approach that is less vulnerable to resistance and environmentally damaging practices. In tropical ecosystems, the interplay among vectors, hosts, and wildlife pathogens presents unique challenges and opportunities for zoonotic disease prevention. Vectors impact not only humans but also wildlife, introducing potential new zoonotic risks. Research into these dynamics enables us to predict emerging threats and design

interventions that prevent zoonotic spillover from animals to humans. Moving forward, interdisciplinary collaboration and sustainable control methods are essential for tackling zoonotic diseases in tropical regions.

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Characterization of physicochemical, nutritional, and shelf-Life properties of Ambul Banana (*Musa acuminata* - AAB) corm flour: by-product of banana cultivation

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Ambul banana (*Musa acuminata* - AAB) corm is an underutilized by-product of banana cultivation. This study evaluated the physicochemical, nutritional, and shelf-life properties of Ambul banana corm flour. Corms collected from Pambahinna, were cleaned, sliced (<1.5 mm thickness) and treated with anti-browning agents for one hour and the best treatment was determined by color analysis. The selected sample was dried using tray and conventional dryers at 60 ± 5 °C for 30 minutes. The optimal processing method for flour was determined by color and yield. Then physicochemical, nutritional, and shelf-life properties of flour were determined using respective methods. The best anti-browning treatment was 0.5% (w/v) Sodium metabisulphite, which achieved the highest L* value (72.51 ± 5.03) over citric acid and lime. Tray drying yielded the maximum flour recovery (10.64 ± 0.42%) with the highest L* value (82.78 ± 0.75). Crude-fiber, ash, moisture, crude-protein, crude-fat, and potassium content of flour was 61.52 ± 6.09%, 9.61 ± 0.04%, 8.23 ± 1.22%, 2.39 ± 0.01%, 1.48 ± 0.03%, and 289.86 ± 2.33 mg/100 g respectively. Steroids, terpenoids, coumarins, and flavonoids were detected as phytochemicals, alongside functional groups as OCO, -COOH, -CH, -COC, -CO, -OCO, -OH, and diketone via FTIR analysis. The measured total phenolic contents were 0.139 ± 0.05 GAE mg/mL (water extract) and 0.318 ±0.24 GAE mg/ (methanol extract). High-density polyethylene containers maintained a stable pH around 6.00 ± 0.12 and moisture content ranging from 7.17% - 6.67% over one month shelf life under ambient conditions. Ambul banana corm flour is a fiber-rich ingredient with promising applications in prebiotic dairy products and fiber-enriched baked goods.

Key words: Ambul banana (AAB), Banana corm, Banana by-product, Dietary fiber, Phytochemicals

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Isolation and characterization of black rot-causing bacteria of cabbage, and isolation of its bacteriophage as a biocontrol agent

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Black rot caused by *Xanthomonas campestris pv. campestris* (Xcc) is one of the most destructive bacterial diseases of economically important Brassicaceae vegetables including cabbage. Available methods to control black rot in cabbage are only preventive and ineffective in controlling the disease once the plant is infected. Phage-mediated biocontrol is considered as a more promising, safe, and environmentally friendly method to control bacterial plant diseases. Therefore, this study was focused on isolating the causative bacteria of black rot of cabbage and isolating their bacteriophages that can be used as a biocontrol agent. Bacterial pathogens were isolated from cabbage leaf samples showing typical black rot symptoms using standard microbiological techniques. Two isolates, namely Xcc-1 and Xcc-2, with yellow-coloured, mucoid colonies were purified and preliminarily identified as *Xanthomonas* spp. using morphological and biochemical characteristics. The UV-visible spectrophotometric analysis of the methanolic extract of the yellow intracellular pigment produced by the bacterial isolates showed a maximum peak near 440 nm with shoulder peaks, which was characteristic of the Xanthomonadin pigment of *Xanthomonas* spp. The pathogenicity of the two bacterial isolates was confirmed by inoculating healthy cabbage leaves. Characteristic disease symptoms were observed after 10 days of incubation. Further, bacteriophages were isolated from diseased cabbage leaves using agar overlay method. The phage isolate Xcc-Ph1, formed visible plaques with both bacterial isolates Xcc-1 and Xcc-2. Although further studies are needed to confirm the biocontrolling ability of Xcc-Ph1, these findings provide a great initiative to develop a bacteriophage-based method to manage Black rot disease in cabbage in the future.

Keywords: Black rot, Cabbage, Phage therapy, Xanthomonas

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Evaluation of the production of biosurfactant from halophilic bacteria isolated from salt pans in Hambantota, Sri Lanka

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Halophilic bacteria are salt-loving and, therefore, can thrive in high-salt environments. They have evolved physiologically and biochemically to survive in these extreme conditions. Recently, halophilic bacteria have gained attention due to their potential for producing biosurfactant-surface-active compounds with applications in environmental remediation, agriculture, and the pharmaceutical industry. This study evaluates the biosurfactant-producing ability of the halophilic bacteria isolated from saltpans in Hambantota, Sri Lanka. Sediment samples were collected from six Maha Lewaya salt pan ponds in Hambantota, Sri Lanka, each pond having different salt densities. Halophilic bacteria were isolated on halophilic agar and incubated for 48 hours at 30°C. Morphologically and biochemically identified bacteria were named HA I, HA II, HA III, HA IV, and HA V. Biosurfactant-producing ability of the isolates was evaluated using different screening methods i.e. cetyltrimethylammonium bromide agar (CTAB) assay, oil-displacement assay, foam formation, and estimation of emulsion index. In the CTAB assay, all five isolates produced blue halos while only four isolates showed stable foam formation. The oil displacement assay showed positive results for all five isolates, with different oil displacement capacities ranging from 0.60 to 7.33 cm clear zone diameter. Emulsification activity varied among the strains, where HA IV showed the lowest (10.33%), and HA I showed the highest (46.43%) emulsion index. According to these results, halophilic bacteria isolated in this study showed significant biosurfactant production abilities, with potential applications in bioremediation, oil recovery, and other industrial processes.

Keywords: Biosurfactants, Halophilic bacteria, Saltpans

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Effect of polyamine seed priming in proline content of *Vigna radiata L.* seedlings under water stress

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Water stress hampers the productivity of *Vigna radiata* L**.** by altering physiochemical properties. Plants adapt to water stress by accumulating proline as an osmoprotectant. Polyamines (PAs) are plant growth regulators that enhance plant stress tolerance. This study investigates the effect of PA-seed priming on proline accumulation in *Vigna radiata* L. seedlings under water stress. Approximately 120 seeds of the "MI 6" variety (FCRDI, Mahailluppallama) were subjected to separate priming treatments for 1 hr using PAs putrescine (Put), spermidine (Spd), and spermine (Spm) (50 µM,100 µM, and 200 µM each) and distilled water (control) in triplicates. The germination rate index was measured by counting the cumulative number of germinated seeds every 24 hr for 2 days. Seeds primed with 200 µM Put, Spd and Spm recorded the highest indices; 130.67, 140.00, and 150.00 respectively. Seedlings aged three weeks, grown from seeds primed with 200µM PAs and distilled water were exposed to two water stress conditions; irrigating to 50% (0.5× field capacity (FC)) and 25% (0.25×FC) of the field capacity. At FC a control group was irrigated. The total proline content of mature leaves was analyzed spectrophotometrically after one week of water stress using 5 replicates. One-way ANOVA revealed significant proline increases in plants obtained from distilled water-primed seeds at 0.5×FC (1.22 $mgml^{-1}$) and 0.25×FC (1.59 $mgml^{-1}$) compared to plants at FC (0.88 $mgml^{-1}$) ($p<0.001$). At both 0.5×FC and 0.25×FC, the proline content was significantly increased as control<Put<Spd<Spm mean values with 1.22<1.31<1.39<1.56 $mgml^{-1}$ ($p<0.001$, F-value 82.58) and 1.59<1.73<1.86<2.09 $mgml^{-1}$ ($p<0.001$, F-value 87.07) respectively. Hence, water stress tolerance in *V. radiata* can be enhanced upon applying PAs by elevating proline content.

Keywords: Polyamines, Proline, Seed priming, Vigna radiata, Waterstress

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Outwelling of dissolved and particulate organic carbon from the Galle/Unawatuna riverine mangrove ecosystem of southern Sri Lanka

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Mangrove carbon assessments typically focus on biomass and soil carbon stocks, often overlooking losses through respiration and lateral export (outwelling). Despite representing ~50% of the total carbon budget, outwelling losses remain understudied, with no previous research documented in Sri Lanka. The present study estimated the outwelling of Dissolved Organic Carbon (DOC) and litter Particulate Organic Carbon (POC) in the Galle/Unawatuna mangrove, Sri Lanka, while identifying temporal variations and factors influencing flux rates. Surface water samples were collected in triplicate alongside parameters (Flow-velocity: Eijkelkamp-2030-Series, Salinity, Temperature, pH, Total Dissolved Solids and Conductivity) from a fixed point at the creek's mouth. Randomly placed litter traps were used to assess litterfall (n=5) and tidally transported litter (n=3). Sampling occurred every two hours (06:00-18:00hrs) from February to August 2022, yielding 294 sampling events across 49 tidal flows. Tide and precipitation data were obtained from the national meteorological department. [DOC] was analyzed using TOC-VCSH, while POC was determined from litter biomass using standard carbon conversion. Flux rates were calculated by combining tidal discharge with [DOC/POC]. DOC showed substantial export (3,281.67 gCm^2year^{-1}) while POC showed net import (4.47±53.6 $gCm^2year^{-}1$), attributed to stronger flood flows retaining macro litter. Time series indicated stationarity for both parameters (ADF=-5.1111, $p<0.01$). Tidal regime dominated DOC export during ebb-flows, while POC flux was influenced by litterfall and precipitation. DOC export exhibited inverse relationships with temperature and salinity ($F=13.86$, $p<0.001$, $R^2=0.4704$). This riverine mangrove system appears to support DOC outwelling, potentially contributing to coastal productivity. Future studies should integrate C/N isotopes to trace mangrove-derived carbon.

Keywords: Dissolved organic carbon, Lateral export, Litter, Outwelling, Particulate Organic Carbon, Riverine mangrove

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Impact of tropical climate modes (Indian ocean dipole and El Niño/Southern oscillation) on winter surface chlorophyll in the Indian ocean

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The Indian Ocean Dipole (IOD) and the El Niño/Southern Oscillation (ENSO) are two dominant climate drivers that significantly influence on ocean dynamics and climate in the tropical oceans. Although previous research has largely focused on the influence of IOD and ENSO on the biophysical interactions that drive marine primary productivity in the Indian Ocean (IO) during the summer, their effects during the winter are underexplored. To address this research gap, this study investigates the diverse effects of IOD and ENSO on the winter surface chlorophyll-a distribution in the IO, analyzing observational and reanalysis data from 1997 to 2023 to assess chlorophyll-a responses. The results show an oscillation in surface chlorophyll-a, with positive IOD and El Niño events causing decreased concentrations (-0.0073 ±0.013 for IOD-induced, -0.0016 ±0.003 for El Niño-induced) in the western IO and increased concentrations (0.0076 ±0.013 for IOD-induced while -0.0087 ±0.00 for El Niño-induced) in the eastern IO, while negative IOD and La Niña phases show the opposite pattern. In particular, IOD exerts a stronger influence on winter surface chlorophyll-a dynamics than ENSO. Nevertheless, the underlying mechanisms driving chlorophyll variability are similar for both climate modes. In the western IO, positive IOD or El Niño-driven downwelling deepens the thermocline and reduces nutrients and chlorophyll-a, while in the eastern IO, the opposite happens. These results highlight the key role of IOD and ENSO in modulating winter surface chlorophyll in the IO, providing insights into biophysical interactions with significant ecological and economic impacts on regional marine ecosystems.

Keywords: Biophysical interaction, El Niño/Southern Oscillation, Indian Ocean Dipole, Indian Ocean Winter

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Mapping the proteomic landscape of *Aeromonas hydrophila* derived extracellular vesicles

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Secretion of nano-sized extracellular vesicles (EVs) is an evolutionary conserved trait of bacteria. Bacterial EVs are involved in intercellular communication with host and other bacteria, nutrient transfer within microbial communities, delivery of virulence factors and toxins, horizontal gene transfer and modulating host immunity. The present study was conducted to analyze the proteome of EVs derived from *Aeromonas hydrophila* (*Ah*EVs), a fish pathogen and investigate their proteomic profile and immune responses. The isolation of *Ah*EVs was done by ultracentrifugation. Transmission electron microscopy and nano-tracking analyses confirmed the spherical shape and the average size (105.5 ± 2.0 nm), respectively. Proteomics of *Ah*EVs revealed the presence of 1,284 identified proteins. Gene Ontology (GO) annotation for protein functions was determined and subcellular localization indicated that "cell" and "cell part" were the primary protein localization areas, together accounting for 46.32% of the structural proteins. Additionally, GO analysis showed a higher number of proteins related to "catalytic activity" (566 proteins) compared to other functions. Results of qRT-PCR analysis revealed differently expressed immune functional genes in *Ah*EV-treated FHM cells and zebrafish. Cellular proinflammatory cytokines such as nuclear factor (NF)-κB, interferon (Ifn), Irf7, interleukin (il) 8, and il11 were upregulated concentration-dependently. *In vivo* gene expression analysis revealed that *Ah*EVs treated (5 mg/fish) adult zebrafish-induced toll-like receptor (*tlr*) *2* and 4, tumor necrosis factor α (*tnfα*), heat shock protein (*hsp*) *70, il6, il10*, and *il1β*. Hence, we suggest that *Ah*EVs could be a novel vaccine candidate in fish medicine due to their ability to elicit strong immune responses.

Keywords: Aeromonas hydrophila, Bacteria, Extracellular vesicles, Proteomics; Zebrafish

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Identification of the cover crop *Pueraria phaseoloides* as a potential alternative host for Circular Leaf Spot Disease (CLSD) of *Hevea brasiliensis* in Sri Lanka

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The Circular leaf spot Disease (CLSD) has emerged as a leaf fall disease of rubber plantations, worldwide including Sri Lanka. Alternative hosts play a crucial role in the survival of pathogens within the fields, that pose challenges for the disease management. Therefore, this study aimed to identify Pueraria phaseoloides as a potential alternative host for CLSD and to study its pathogenicity on the main crop. The cover crop Pueraria phaseoloides was selected for investigation due to its symptoms resembling CLSD infected rubber leaves. The fungi isolated on Potato Dextrose Agar were characterized based on their morphological features. Among the fungal isolates, Colletotrichum sp. and Pestalotioid isolate were identified and isolated consistently from P. phaseoloides. Single spore isolates of pathogens were maintained and their pathogenicity was proven through the Koch's postulates using the seedlings of P. phaseoloides. The cross infection abilities were also proven using detached leaf assay with mycelium plugs and conidial suspensions of the two fungal isolates. The results showed that, isolated fungi caused CLSD symptoms on P. phaseoloides similar to those on rubber. Notably, the Colletotrichum sp. isolate was highly pathogenic on rubber than Pestalotioid isolates as indicated by a significant difference ($p < 0.05$). This study provides the first documented evidence confirming that the cover crop Pueraria phaseoloides serves as an alternative host for CLSD affecting rubber plants in Sri Lanka. Further studies should be undertaken with the molecular characterization of the isolated fungal pathogens in order to confirm their identity.

Keywords: Alternative hosts, Circular Leaf spot disease, Pueraria phaseoloides, Rubber plants

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Habitat connectivity of neighboring mangrove forests on the southern coast of Sri Lanka: Tracking experiment carried out by using mangrove propagules

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Mangroves produce hydrochorous mangrove propagules that can disperse via ocean currents allowing them to colonize new habitats successfully. Facilitating this natural process helps to restore degraded mangrove forests near well-functioning mangrove ecosystems in restoration practices. To implement this strategy effectively, the physical connectivity inter-site propagule dispersal should be assessed first. This concept was explored in a study focusing on three adjacent lagoons in southern Sri Lanka: Rekawa (well-functioning), Kahandamodara (partially degraded), and Kalametiya (highly degraded). A tracking experiment was conducted using 1,500 propagules (500 per lagoon) from *Rhizophora mucronata* and *Rhizophora apiculata*, combined with mini GPS tracking devices to monitor dispersal pathways. Propagules were released from five locations in each lagoon and trapped every three days for two months. The study observed both intra-site and inter-lagoon propagule movements. The data were analyzed by calculating the correlation matrix and covariance matrix. The results indicated a 49% correlation and high positive covariance (18.73) between Rekawa and Kahandamodara lagoons suggesting the 49% connectivity. Although no inter-lagoon dispersal was observed, significant intra-site dispersal occurred. Mangrove species along the water's edge were identified using remote sensing data, confirming adequate propagule production in all three lagoons. Possible barriers to propagule dispersal such as fishing nets, sandbar formations, dense mangrove roots, artificial dykes, and a harbor in Kalametiya lagoon were identified. A computational flow model was developed to understand the fate of propagules. The findings from this study provide valuable insights into mangrove restoration practices, highlighting the importance of considering natural recruitment and physical connectivity.

Keywords: Dispersal, Mangrove propagule, Natural Recruitment, Physical Connectivity, Restoration

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Efficacy of ecological niche modelling in predicting climate change impacts on "Kalu Nika" (*Litsea iteodaphne* (Nees) Hook. f.)

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Litsea iteodaphne, a native plant species listed in the vulnerable category of the Red List of Sri Lanka for its limited distribution in the lowland wet zone. Hence, it is likely to experience shifts in its geographic distribution due to rising temperatures and changes in the rainfall pattern of global climate change. This study aimed to predict its geographic distribution from 2021 to 2100 using MaxEnt Ecological Niche Modelling, which applies the principle of maximum entropy to estimate the species' probability distribution based on current and future environmental conditions. We used 95 occurrence records and integrated key determinants: annual mean temperature, precipitation of the driest month, and precipitation of the warmest quarter, among the 19 bioclimatic variables into the model, and the model's reliability was affirmed by high Area Under the Curve (AUC) values, all exceeding 0.8, indicating robust performance. The findings indicated that L. iteodaphne currently inhabits the Western, Southern, Sabaragamuwa, and Central provinces, with the highest distribution in Ratnapura and Nuwara Eliya. The model predicts that, by 2040, the distribution will remain broadly similar, although a slight reduction of extent is expected in Ratnapura, which currently receives high rainfall in the wet zone. Projections for 2061-2100 showed relatively stable conditions in the species' distribution with only minor shifts, particularly a slight westward movement in Nuwara Eliya. The results showed that, under the SSP5-8.5 high-emissions scenario, the distribution of L. iteodaphne as a forest understory species remains relatively stable to climate change. Given its potential vulnerability to non-climate-driven factors, future research on its dispersal and habitat dynamics is recommended to provide a more comprehensive understanding for protecting its habitat and ensuring its survival.

Keywords: Ecological Niche Modelling, Litsea iteodaphne, MaxEnt

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Identification of mother palms for WCLWD-resistant coconut clones using molecular pathogen diagnosis

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Weligama Coconut Leaf Wilt Disease (WCLWD), caused by a phytoplasma, has led to considerable economic losses in coconut production in Southern Sri Lanka since 2006. From 2008 to 2021, 339271 infected coconut palms were removed, as eradication was the only available control measure. By 2021, the disease had spread, affecting approximately 5% of coconut-growing lands. Developing WCLWD-resistant coconut clones through tissue culture offers a promising solution to combat the disease. This study aimed to identify such mother palm candidates by evaluating resistance to WCLWD among different coconut hybrids developed by the Coconut Research Institute, Sri Lanka. Leaf samples were collected from 10-symptomatic and 40-asymptomatic palms of *CRIC60*, *CRIC65-G*, *CRIC65-Y*, *CRISL2020*, *CRISL98*, *Kapruwana*, *Kapsuwaya*, *TBGD*, *Green Dwarf*, and *San Ramon* varieties at the Wilegoda estate, Mirissa, representing local coconut varieties. Pathogen detection was performed using nested-PCR with primers targeting the 16S rRNA intergenic regions. Visual field evaluation showed no significant differences in susceptibility to WCLWD across the coconut hybrids. Molecular diagnosis detected WCLWD-phytoplasma in 3 out of 10 symptomatic palms (27th, 67th, and 150th) and 1 out of 40 asymptomatic palms (52nd), indicating a latent infection. These results confirm the exclusion of these palms as potential mother palms. The remaining symptomatic palms may have a low phytoplasma load or uneven distribution of phytoplasma within the host plant. Asymptomatic palms tested negative for the pathogen can be considered potential candidates for producing WCLWD-resistant clones, subjecting to repeat nested-PCR confirmation. Furthermore, the observed latent period poses challenges for field identification of WCLWD-affected palms.

Keywords: Coconut Hybrids; Latent Period; Nested PCR; Phytoplasma-Associated Disease

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Comparative study on the genotoxicity of sodium benzoate and sodium metabisulfite on root tips of *Allium cepa* assay

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Sodium benzoate (SB) (E211) and Sodium metabisulfite (SMB) (E223) are common food preservatives. However, studies indicate that some food preservatives may pose health risks due to their potential genotoxicity. In the current study, genotoxicity of SB and SMB on chromosomes of *Allium cepa* was evaluated through the chromosomal aberration, C-mitosis. Roots of *A. cepa* bulbs were treated with 100 ppm, 200 ppm, and 300 ppm of SB and SMB considering the established Acceptable Daily Intake levels. Exposure periods were 24h, 48h and 72h. Distilled water was used as negative control. For each concentration of each exposure period, five replicates were used and a total of 30 root tips were excised. By staining roots with acetocarmine, cells with C-mitosis were identified compared to the metaphase of the negative control. The percentage of cells with C-mitosis was calculated through microscopic observation. From one root tip, a total of 1000 cells were scored under ×400 magnification. Results were analysed using the General Linear Model and Tukey's test at a 95% confidence level ($P \leq 0.05$). The percentages of C-mitosis induced by 100 ppm SB and SMB after 24 h were 0.757%, 0.117% respectively, while after 72 h with 300 ppm, SB induced 2.698% and SMB 0.450%. After 72 h, 300ppm of SB induced the highest percentage of C-mitosis. Both SB and SMB can induce C-mitosis in chromosomes of *A. cepa*, but the induction was significantly ($p=0.001$) higher in SB than SMB over time. Consequently, it can be concluded that SB is more genotoxic than SMB. Therefore, excessive consumption of SB-containing foods may cause genotoxic effects on humans.

Key words: Allium cepa L.,C-mitosis, Genotoxicity, Sodium benzoate, Sodium metabisulfite

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Composition of soil seed banks in five selected tanks in Kuliyapitiya, Sri Lanka, with special reference to tank's parkland/ ephemeral wetland

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Soil seed banks play a significant role in the vegetation diversity of ephemeral wetlands, enabling many species to survive through unpredictable periods of adverse conditions. This study was carried out to explore the seed bank compositions of tank's parkland/ ephemeral wetland regions in five small tanks in Kuliyapitiya, which were named according to their first letter (D, P, T, U and W). Six random soil samples (30 cm x 30 cm x 5 cm) were collected from the parkland of each tank during the dry season. The seed bank compositions of each tank were studied using the seedling emergence method. Shannon-Wiener and Sorenson similarity indexes were used to study the biodiversity of soil seed banks and the similarity between tanks, respectively. Twenty- three plant species belonging to 15 different families were recorded. The aquatic, terrestrial and wetland species present in the tanks were 39%, 39% and 22%. The Shannon-wiener index for seed banks of tanks ranges from 0.562- 1.958. The highest similarity was observed between tanks D and U (0.74) while the least in tanks D and P (0.30) respectively. The highest and least total seed densities were reported in tank T (283×10^3 seeds m^{-3}) and tank P (59×10^3 seeds m^{-3}). Considering the seed density, the seed banks were dominated by *Ceratopteris thalictroides*, *Cyperus iria*, *Utricularia striatula* and *Ludwigia peruviana*. Therefore the soil seed banks of the ephemeral Wetland region of the selected tanks were rich in species diversity and dominated by both wetland and terrestrial species.

Keywords: Ephemeral wetlands, Seedling emergence, Seed bank, Tank ecosystem, Weeds

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Effect of volatiles emitted by three botanicals on second-stage juveniles of root knot nematode, *Meloidogyne javanica: An in vitro* study

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Root-knot nematodes (*Meloidogyne* spp.) pose a major constraint in agro-industry. In this study, the effect of volatiles (VOCs) emitted from dry macerates of *Morinda citrifolia* (Sinhala "*Ahu*") leaves and, flowers and leaves of *Calotropis gigantea* (Sinhala "*Wara*") on infective juveniles (IJs) of *Meloidogyne javanica* were determined. Percentage mortality and paralysis of IJs caused by the VOCs were recorded with three rates of the macerate (5, 10, and 15 g), at three VOC exposure times (24, 48, and 72 h), with five replications. Sterile distilled water was used as the untreated control. Data on mortality and paralysis was subjected to arcsine square root transformation prior to the statistical analysis. One-way ANOVA was used to determine the effect of the VOCs on nematodes and mean comparison was done using LSD multiple range test. In untreated controls, zero mortality in IJs was recorded. The volatiles emitted from *M. citrifolia* significantly increased (P<0.0001) the juvenile mortality with the increasing rate of the macerate and exposure time. However, VOCs released by two macerates of *C. gigantea*, increased IJs mortality (P<0.0001) only at 24 h and 48 h; at 72 h, no significant difference was detected in IJs mortality (P>0.05) among the three rates. At all rates, VOCs emitted by the leaf macerate of *C. gigantea* induced a significantly higher IJs morality (P<0.0001) compared to *M. citrifolia* at all the exposure times, and compared to *C. gigantea* flower macerate at 24 h and 48 h. A hundred percent of IJs mortality was induced by the leaf extract of *C. gigantea* with the rates of 10 g and 15 g of the macerate at 72 h. The IJs mortality caused by VOCs of flower macerate of *C. gigantea* ranged 98-99% at 72 h. The highest juvenile mortality recorded with *M. citrifolia* was 55%. It caused significantly higher paralysis (P<0.0001) in *Meloidogyne* juveniles compared to *C. gigantea* with the highest recorded value of 55.13 ± 1.94. The VOCs emitted from all three botanicals were potentially nematotoxic. Further trials are needed to characterize the volatiles.

Keywords: Exposure time, Macerates, Meloidogyne javanica, Volatiles

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Formulation and quality assessment of mushroom-based sausage using Oyster Mushrooms (*Pleurotus ostreatus L.*)

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Mushrooms are rich source of protein, fiber and bioactive compounds making them an excellent alternative for developing plant-based meat substitutes. This study explores the development of a sustainable and nutritious vegetarian sausage using oyster mushrooms (*Pleurotus ostreatus* L.) and rice flour, without the addition of artificial preservatives. Blanched and blended mushrooms were mixed with rice flour in 80:20 (T1), 75:25 (T2), and 70:30 (T3) (w/w) ratios to develop three different formulations. Preliminary experiments were conducted to determine the optimal amounts of culinary blend and salt required for the mushroom-rice flour sausage mix. The sensory evaluation was conducted using 30 semi-trained panelists with 5-point hedonic scale and data were analyzed using Kruskal-Wallis non-parametric method. The proximate composition, physicochemical properties and shelf-life of the developed product which was packed in high density polyethylene (HDPE) were assessed using standard methods. Sensory testing revealed that T1 formulation (80:20, mushroom: rice flour) had the highest consumer preference compared to the other formulations. Proximate analysis of T1 showed it contained 68.94±0.06% moisture, 2.11±0.03% ash, 9.62±0.5% crude fat, 6.13±0.007% crude protein, 2.24±0.22% crude fiber and 10.96±0.25% carbohydrates. No significant differences ($p<0.05$) were observed in pH or color (initial values of L* - 33.89±0.87, a*- 13.32±1.08, and b*- 20.30±0.74) changes during the storage period. The developed product showed no signs of bacterial or mold growth over a 42-day storage period under frozen conditions (-4±2 °C). It can be concluded that the developed sausage, containing 80% (w/w) mushroom, was safe for consumption for up to 1.5 months under frozen storage conditions.

Keywords: Oyster mushrooms, Rice flour, Sausage, Sensory evaluation, Shelf-life analysis

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Effect of training and pruning methods on growth and yield of Salad Cucumber (*Cucumis sativus* L.) under protected house conditions

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Most of the Sri Lankan polytunnels, with gable heights of 8-9 ft, struggle with salad cucumber production due to the necessity of over 9 training cycles per season (120 days). This leads to a higher cost of production, diminishes productivity and increases fruit damage while using the conventional coiling method for training, limiting cropping cycles annually, highlighting the need for efficient, flexible training techniques to optimize salad cucumber growth and yield in polytunnels. This study aims to investigate the impact of four training methods on the growth and yield parameters of salad cucumbers grown in a poly tunnel following a Completely Randomized Design. The experiment comprised four training methods: T1(hanging method), T2(pull down and coiling of the main stem at the base of vine), T3 (pinching apical bud at 6 ft), and T4(pinching apical bud at 6 ft with applying 10% gibberellic acid) with four replicates followed by all recommended agronomic practices. Growth and yield data were collected and statistically analyzed using analysis of variance. Means were separated by Duncan's Multiple Range Test at 5% probability level. The results revealed that there was no significant difference in the stem girth ($P>0.16$), leaf area ($P>0.26$), productive flowers/vines ($P>0.71$), and weight of fruits/vines ($P>0.73$). The research concludes that while growth and yield showed no significant differences across four training methods, farmers can use T3 and T4 for gable height under 12 ft. To control fruit damage, T2 can be avoided, and T1 is suitable for height over 12 ft, emphasizing cost effectiveness and flexibility.

Keywords: Growth, Poly tunnel, Salad cucumber, Training methods, Yield

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Effect of iron (Fe^{2+}) stress on yield and yield components of selected high yielding rice varieties under Low Country Wet Zone (LCWZ) field conditions

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Iron (Fe^{2+}) toxicity is a common soil nutritional disorder that significantly reduces rice yields, particularly in Sri Lanka's Low Country Wet Zone. This study aimed to assess the effects of Fe^{2+} toxicity on grain yield and various yield components of selected high-yielding rice varieties and to analyze their sensitivity to iron toxicity. A field screening experiment was conducted during the 2023–2024 Maha season at the Regional Rice Research and Development Centre, Bombuwala, using 15 rice varieties;(*BW272-6b, Bg359, Bg374, BW302, At311, BW266-7, BW312, BW361, Bg300, BW367, BW372, BW364, BW267-3, BW 351, and BW363*). The experiment was carried out at a site with high Fe^{2+} levels (294.45 to 317.10 mg kg−1), known to induce toxic effects, while a control site with lower levels (78.90 to 112.63 mg kg^{-1}) was also used. Grain yield per plant was measured, along with plant height, tiller number, 1000 grain weight, panicle length, and fertility (filled and unfilled grains per panicle) as key yield components. A Generalized Linear Model was applied to determine the significant differences between treatments and rice varieties. The results indicated that varieties *BW267-3, BW367, BW363, BW372, BW302, BW 351, Bg 374* and *At311* showed no significant differences in yield and yield components compared to the control, classifying them as highly tolerant to Fe^{2+} toxicity. In contrast, varieties *BW272-6b* and *Bg359* demonstrated significant reductions in yield (33%), 1000 grain weight (40%), fertility (25%), plant height (18%), and tillering (33%), categorizing them as susceptible. Varieties *BW266-7, BW312, BW361, Bg300,* and *BW364* were moderately affected and classified as moderately tolerant. Further research is recommended to confirm their tolerance levels.

Keywords: Field screening, High-yielding rice varieties, Iron toxicity, Susceptibility, Tolerance

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Effects of LDPE mulching generated microplastics on the germination of *Phaseolus vulgaris* L.

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Use of plastic mulching, especially low-density polyethylene (LDPE) is prevalent in agriculture for its many advantages. LDPE mulches generate microplastics (MPs) through abrasions and degradation, contributing to environmental concerns. Plant growth including seed germination, root and shoot elongation; soil composition, and microbial diversity are altered by these MPs. This study aimed to evaluate the impact on the germination of common bean (*Phaseolus vulgaris* L.) seeds (Certified by the Department of Agriculture, Sri Lanka), by MP (≤1000µm; arbitrarily shaped) generated through LDPE mulching. Seeds (75% viability) were sown into seed trays containing soil amended with 0% (control), 1%, 3%, and 5% (w/w dry weight of soil) concentrations of LDPE-MPs. MP contamination in the soil was verified prior to the experiment, using Fourier-transform infrared spectroscopy. Germination was observed for 14 consecutive days of sowing. Germination Percentage (GP), Germination Index (GI), Germination Rate Index (GRI), and Mean Germination Time (MGT) were calculated. A regression model followed by Tukey Pairwise Comparison test and descriptive data analysis were used to analyze the data. Compared to the control, GP decreased significantly (p-value=0.000) by 12.80%, 23.81%, and 32.54% respectively at 1%, 3%, and 5% w/w LDPE-MP, over the 14 days. In comparison to the control, the decline in GI and GRI and increase in MGT were seen with all LDPE-MP treatments. Concentration-dependent variation of the germination indices under different concentrations of LDPE-MP suggests that soil LDPE-MP disrupts the common bean seed germination in a concentration-dependent manner. Further studies are required to uncover the potential causes.

Keywords: Common bean, Microplastics, Seed germination.

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Diversity and abundance of soil nematode community associated in bitter-gourd (*Momordica charantia* L.) fields maintained with conventional and good agricultural practices (GAP)

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Soil nematodes are ubiquitous in soil ecosystems, and they contribute to soil nutrient recycling and the decomposition of organic matter. To date, only a handful of research work has been focused on soil nematode assemblage associated with agricultural fields in Sri Lanka. The objective of this study was to identify and assess the abundance of the soil nematode community associated with the rhizosphere region of Good Agricultural Practices (GAP) and conventionally-managed Bitter gourd fields located in Mirissa (Matara District, Sri Lanka), at three depths (0-5, 5-10, and 10-15 cm), over three-months period. Monthly sampling was conducted at two fields of each cultivation practice by selecting five plants, using systematic random sampling. At each depth, five soil cores (125 g) were taken and nematode abundance was assessed in three replicates of 100 g sub-samples and reported as the averages. Randomly selected 150 nematodes were taxonomically identified up to the Genus level only. The overall abundance of nematodes in GAP fields (730.20 ± 109.03) was higher (P <0.001) than in the conventional fields (482.60 ± 92.78). A decrease (P<0.05) in nematode abundance was detected with the increasing soil depth. In GAP fields, greater nematode counts were recorded at the depths of 0-5 cm (P<0.022) and 5-10 cm (P <0.001) when compared with those in conventional fields. At all three depths, the nematode juveniles outnumbered the adults (GAP: P<0.020; conventional P<0.020). Four feeding groups: bacterivorous, omnivorous, predators, and plant feeders were found in both types of fields. Among them, predatory nematode abundance was found to be the lowest (P<0.001) whereas plant feeders outnumbered all the other feeding groups. In both practices, the abundance of plant feeders was significantly higher (P<0.001) compared to the other feeding groups at the depth of 0-5cm. The findings of this study fill the knowledge gap in soil nematode assemblage in Sri Lanka.

Keywords: Abundance, feeding, nematodes, soil depth

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Presence of Fishing Cats in Kirala Kale sanctuary, Matara, Southern Sri Lanka and their dietary profiles

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The fishing cat (*Prionailurus viverinus*) (Mammalia: Felidae) is an endangered nocturnal mammal living in water associated habitats, recorded in hill country wet zone and dry zone forests of Sri Lanka. The objectives of the present study were to investigate the presence of fishing cats in Kirala Kale using camera traps, community interviews, scat and to determine the dietary profile using scat samples. Location geo-coordinates were recorded of the spots where scat was found and camera traps were set up. A total of 60 scat samples were collected using random sampling method along trails and gravel roads, covering rainy (August -October 2023) and dry (November 2023- February 2024) periods. A home range map was generated using GPS data in ArcGIS 10.4. Undigested prey body parts were identified and classified into taxonomic groups. Presence of fishing cats was indicated by characteristic features of scat and through community interviews. Camera traps confirmed the presence of at least two fishing cats in Kirala Kale sanctuary. Their home range seem to be deviated in the rainy period probably due to increased roosting and breeding sites of migratory and non-migratory water birds in the sanctuary. Analysis of scat indicated that birds (33.65%) were the primary prey, followed by mammals (25.96%) and fish (21.15%). Minor prey items included insects, crustaceans and vegetable matter. There was no significant difference in prey composition between the rainy and dry periods. The dietary niche breadth value (0.54) indicated an opportunistic behavior of fishing cats in Kirala Kale. Macroscopic plastics in scat (n=2) indicated transferring non-degradable matter through prey animals. Interviews revealed that people have an awareness of the presence of fishing cats in Kirala Kale, and there is a likely fishing cat-human conflict primarily due to predation on domestic animals.

Keywords: Felidae, fishing cat diet, home range mapping, scat analysis

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A study on the intestinal parasitic community in albino rats

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Albino rats (*Rattus norvegicus*) are frequently used laboratory animals. This survey was conducted for three months using 30 albino rats reared in the animal house, Department of Zoology, University of Ruhuna to examine intestinal parasitic abundance within them. Intestinal contents were observed by dividing the intestine into five areas; duodenum, jejunum, ileum, colon, and rectum. Wet mount method, and Giemsa and Borax carmine staining procedures were used for the observations. Parasitic genera were identified using morphological features and movements through microscopy. Kruskal-Wallis and Mann-Whitney-U tests were used for the statistical analysis. Most of the identified parasites were protozoans including *Entamoeba* sp., *Eimeria* sp., *Giardia* sp., *Trichomonas* sp., *Chilomastix* sp., *Spironucleus* sp., *Tritrichomonas* sp. and *Balantidium* sp. There were few Acanthocephalans including *Moniliformis moniliformis*, and Platyhelminths including *Hymenolepis diminuta*. The most abundant genus was *Trichomonas* (38.09%) while *Balantidium* (0.67%) was the least abundant. There was a significant difference in the abundance of each parasitic species among observed areas ($P<0.05$) but no significant difference between the parasitic abundance between small intestine and large intestine ($P= 0.60$). Jejunum had the highest species richness and diversity while rectum had the lowest. Most rats were infected with *Trichomonas* sp. and *Eimeria* sp. while a few were infected with *Balantidium* sp. According to the Pearson correlation analysis, there was no significant relationship between the overall intestinal parasitic percentages and the weight of rats ($P = 0.467$). Mix infections of parasites were more common than single infections within this community. All tested albino rats were infected with parasites.

Keywords: Abundance, albino rats, intestinal parasites, intestine, protozoans

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Effects of waterborne sodium dodecyl sulphate on behavior and erythrocyte nuclear morphology of tilapia (*Oreochromis niloticus*) juveniles

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Anionic surfactant Sodium Dodecyl Sulphate (SDS) used in industrial and domestic products may unintentionally harm aquatic life, if not treated before release. This study examined the biological effects of waterborne SDS on laboratory-reared *Oreochromis niloticus* juvenile (Tilapia) fish. A range finding test preceded the experiment to assess the possible toxicity of SDS having the upper limit as the reported maximum permissible level in surface water (0.01, 0.1, 1 mg/L). The experiment was carried out with fish (5.0 -7.0 cm total length) in two treatment groups each with 500µg/L (T1) and 1000 µg/L (T2) SDS in water and one control (no SDS) in three replicates, under static renewal of the tank water on every fourth day over 28 days. Similar feeding and moderate aeration levels were maintained across all tanks, and water quality parameters (temperature, pH, conductivity, dissolved oxygen, total dissolved solids, total ammonia, nitrates and phosphate levels) were monitored between renewals. Individual fish data (n=12 per group) was collected for Liver Somatic Index (LSI), behavioral level endpoints (ventilation rate, tactile response, food detection time, swimming motion), and genotoxic level endpoint (Erythrocyte Nuclear Abnormality, ENA) on day 14 and day 28. At both sampling points, LSI was not affected by exposure ($p>0.05$). A lower ventilation rate ($p<0.05$), an enhanced response to tactile stimulus ($p<0.05$) and delayed detection of food pellets ($p<0.05$) compared to the control group were observed in both SDS-exposed groups on day 28. Swimming motion was not affected by SDS. The frequencies of the micronuclei, notched nuclei, blebbed nuclei and apoptotic nuclei were higher ($p<0.05$) in both treatment groups than in the control (per 1000 erythrocytes) on day 14 and day 28. SDS-exposed groups showed significantly higher frequencies of total nuclear abnormalities at both sampling points while showing more effect at the higher SDS level. The time-dependent effect was not consistent in all parameters. Water quality parameters remained without any significant difference across the three groups throughout the experiment ($p>0.05$), indicating that the effects observed are attributable to the SDS exposure alone. The findings suggest that waterborne SDS affect Tilapia juveniles, causing some changes in their behaviour and erythrocyte nuclear morphology even at the reported maximum permissible levels for surface water (1 mg/L) and potable water (0.5 mg/L).

Keywords: ENA, food detection, genotoxicity, liver somatic index, touch response, ventilation rate
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Effects of aquatic and roosting avifauna on water quality of the selected freshwater ecosystems in Southern Sri Lanka

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High associations of waterbirds and roosting birds result in allochthonous nutrient inputs into aquatic ecosystems due to their fecal matter. The present study was undertaken in three selected bird roosting areas in southern Sri Lanka, *i.e.*, the University of Ruhuna (UOR), Rekawa (REK), and Kirala Kele Sanctuary, to determine the effect of the aquatic and roosting avifauna on the water quality and ornithological eutrophication status. Data were collected from October 2023 to February 2024. Guanotrophication and ornithological eutrophication was confirmed by assessing the chlorophyll, nitrate, and phosphate contents and other selected physicochemical parameters of the water samples collected from three sites: beneath the roosting area (RS), 50m away from the roosting site (NRS), and an aquatic ecosystem away from the roosting site (CS). The quadrat method was used to collect the bird droppings. The status of eutrophication was determined by using the Trophic State Index (TSI). Among the bio-indicators, conventional sampling of macroinvertebrates was used to assess the eutrophication status. Statistical analysis and Tukey pairwise comparisons showed that all physico-chemical parameters are significantly different ($p<0.05$) among three sites in each location. A greater amount of chlorophyll (40.09 ± 1.30), nitrate (2.08 ± 0.05), and phosphate (2.09 ± 0.29) contents were recorded at the roosting site (RS) compared to NRS and CS areas in the Kirala Kele sanctuary, where the highest incidence of ornithological eutrophication was recorded among three locations. Similarly, the other two locations showed higher chlorophyll, nitrate, and phosphate values at the RS than the NRS and CS. High nitrate and phosphate contents from bird droppings were found at the UOR (nitrate: 4.36 ± 0.040, phosphate: 0.31 ± 0.079). The highest abundance of macroinvertebrates was recorded from the RS areas, whereas the lowest was recorded from the CS areas. The highest TSI for the roosting site was found in the Kirala Kele sanctuary (TSI = 46.06). The findings of this study highlight that droppings of roosting and aquatic birds in Southern Sri Lanka contribute to eutrophication.

Keywords: Guanotrophication, ornithological eutrophication, Trophic State Index, waterbirds

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Circulating 5α-dihydroprogesterone (5α-DHP) and progesterone concentrations during pregnancy: A case study of a Bengal tigress (*Panthera tigris tigris*) in a safari park in Sri Lanka

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Bengal tigers (*Panthera tigris tigris*) are endangered and hence understanding their endocrine status during pregnancy is crucial for their breeding and conservation in captivity. The objective of the present case study was to examine the dynamics of circulating 5α-dihydroprogesterone (5α-DHP) and progesterone concentrations in a Bengal tigress during pregnancy and to investigate the relationship between the concentrations of these two hormones. Serial blood samples (n = 14; varying sampling intervals) were collected from Leo, a 5 years old Bengal tigress in a Safari Park in Sri Lanka, through the medial saphenous vein. The hormone concentrations were measured using previously reported enzyme immunoassays. The 5α-DHP concentrations were measured in 7 samples after observing the mating period while progesterone concentrations were measured in all samples. The sensitivity of 5α-DHP and progesterone assays were 0.098 - 100 ng/mL and 0.156 - 40 ng/mL, respectively. Circulating 5α-DHP and progesterone concentrations of Leo ranged between 0.04 - 24.93 ng/mL (n = 7), and 0.06 - 16.54 ng/mL (n = 14), respectively. The two samples obtained within 8 - 10 weeks postcoital period showed extremely high 5α-DHP (16 to 18-fold) and progesterone (6 to 8-fold) concentrations compared with the sample obtained prior to mating period. Interestingly, 5α-DHP concentrations increased by 3.5-fold just 5 days after mating period. A very strong correlation was observed ($r = 0.97$; $P < 0.0001$; $n = 7$) between serum 5α-DHP and progesterone concentrations. In conclusion, circulating 5α-DHP and progesterone concentrations markedly increased during the pregnancy in Leo and therefore can be potentially employed in pregnancy diagnosis of Bengal tigresses.

Keywords: Bengal tiger, ELISA, Hormone, Pregnancy, Serum

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Use of waste materials to develop an innovative filtration system for sustainable household aquaponics

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Aquaponic integrates aquaculture and hydroponics in a symbiotic environment, relying on filtration to convert fish waste into plant nutrients. This study handles to evaluate the selected waste materials as efficient filters in aquaponic systems, addressing waste management issues from solid waste generation. The objective of the study was to evaluate the performance and effectiveness of selected waste as filters compared to standard filter material. Nile tilapia (*Oreochromis niloticus*) GIFT strain and Kankung (*Ipomea aquatica)* were the fish and plant species used in the study respectively. The experiment included five treatments (clay roof tiles, shredded rubber tires, nylon net scraps, biochar, paddy husk) and a control (gravel), each with five replicates. Completely Randomized Design was used, and treatment effects were analyzed with one-way ANOVA followed by Dunnett's test for mean comparison. Mean leaf number and leaf diameter of *I. aquatica* differed significantly (p=0.05), with Dunnett's test indicating significant differences for clay roof tile, nylon net scraps, biochar and paddy husk compared to the control. Nitrate concentrations (ppm) in water were 11.5 (clay roof tile), 3.5 (shredded rubber tire), 4.1 (nylon net scraps), 5.4 (biochar), 5 (paddy husk), and 2.5 (gravel), whereas the corresponding pH values were 7.24, 6.65, 6.95, 7.34, 6.49, and 7.24. Within the system, temperature ranges between 29-30°C and Ammonia concentrations fluctuated around 0.17-0.28 mg/L. Over six months of physical and visual observations, only clay roof tiles and biochar showed no clogging or degradation. Based on the results, we can conclude that clay roof tile and biochar have excellent filtering properties and could be employed effectively as filters in aquaponic systems.

Keywords: Aquaponics, Biofilter, Efficiency, Sustainability, Recycled Materials
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Histamine variation in selected Scombridae fish in response to environmental exposure over time

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Scombridae fish are highly responsible for histamine fish poisoning. Histamine levels are considered a key indicator of fish quality. This study examined histamine variation in selected Scombridae fish; frigate tuna (*Auxis thazard*), skipjack tuna (*Katsuwonus pelamis*), and mackerel tuna (*Euthynnus affinis*) in response to environmental exposure over time. Twenty fish from each species were collected from open fish markets in Maharagama, Sri Lanka, from 8 a.m. to 9 a.m. Initial histamine concentrations were measured immediately after collection. The collected fish were divided into two groups. Test samples remained at room temperature, exposed to lux, and sprayed water occasionally, while control samples were maintained under ice. Histamine concentrations were recorded at intervals of 2, 4, 6, and 8 hours for both test and control groups. Histamine levels were quantified using HPLC-DAD. The results indicated initial histamine concentrations of 12.91 ± 0.27 mg/kg, 27.17 ± 0.63 mg/kg, and 24.91 ± 0.16 mg/kg in frigate tuna, skipjack tuna, and mackerel tuna, respectively in test samples (mean ± SD). Over time, histamine levels in frigate tuna, skipjack tuna, and mackerel tuna showed an increase, with concentrations reaching 15.02 ± 0.93 mg/kg, 29.01 ± 0.41 mg/kg, 25.98 ± 0.18 mg/kg, respectively, after 8 hours of exposure. Histamine levels in the control groups were lower than those detected in the test groups. The findings suggest that histamine concentrations in Scombridae fish increase with prolonged environmental exposure. It is recommended that fish be consumed without prolonged exposure to environmental conditions to maintain quality and freshness. Storing fish on ice is recommended to inhibit histamine formation caused by environmental exposure in open market conditions.

Keywords: Environmental exposure time; Frigate tuna; Mackerel tuna; Open market; Skipjack tuna

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Current status and impending potential of Siamese fighter fish (*Betta splendens*) farming: A survey-based case study in Colombo District, Sri Lanka

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Rich biodiversity and favorable geographical conditions of Sri Lanka present opportunities for a thriving ornamental fish industry. This research aims to fill knowledge gaps in Siamese fighter fish (*Betta splendens*) farming in Colombo district. A comprehensive survey was conducted with 36 fish farmers across five secretarial divisions in Colombo district selected with the highest contribution to the industry. Structured questionnaire and focus group discussions were conducted to collect primary data from July to September 2024 to assess the current practices of *Betta* fish farms followed by SWOT analysis. Demographic characteristics revealed that farming is dominated by middle-aged male farmers with different educational levels and occupations. Training and experience analysis highlighted the significance of formal training. Operational practices mainly included breeding, rearing and grow-out activities, and most depend on own sources of fingerlings. Rosetail and Halfmoon strains are particularly in demand in local and export markets. Mostly found diseases in fighter fish farming were Dropsy (32.91%) followed with White spot (22.79%). Marketing survey showed that 58.33% of farmers target both local and export markets. Competitive presence in local market with their willingness for joining export market highlighted market opportunities. High feed costs, infrastructure constraints, and lack of quality brooders were identified as challenges. By considering the SWOT analysis, *Betta* farming in Colombo District shows a higher growth potential with high export market demand, strong lifespan, and ability to produce new strains as strengths. However, addressing challenges with improving management practices is essential for sustainable development of industry.

Keywords*:* Fighter fish farming, Operational practices, SWOT analysis, Training and experience

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A novel approach to the development of a classification model for assessing osteoporosis using DEXA

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Osteoporosis is often asymptomatic until significant damage has occurred. It mainly affects older adults, especially postmenopausal women, due to hormonal changes. Management of lifestyle changes, medications, and preventive strategies are required to maintain bone health and reduce fractures. Therefore, understanding osteoporosis is essential for effective interventions and better patient outcomes. The methodologies employed in this study validate the stage of osteoporosis from DEXA scan reports and identify the demographic factors influencing the condition. Demographic features were analyzed for their relationships with the stages of Osteoporosis using correlation analysis in SPSS software. Among these, weight and menopause age exhibited the highest positive and negative correlation, respectively. To create a classification model, images were categorized into stages as specified in DEXA reports. The third lumbar region of the spine was outlined manually in MATLAB for each patient. From these regions of interest (ROIs), various GLCM texture features were calculated and ANOVA tests were conducted for each feature after confirming their normality through separate box plots. For supervised learning, a Support Vector Machine (SVM) was used. The frequent observation of near-1 AUC values indicates that the predictions achieved satisfactory quality. As the model demonstrates accuracy of 46.49%, future studies will focus on improving it by increasing the dataset size, as only 300 patients were used to train the machine learning model. Furthermore, the accuracy of the model could potentially be enhanced by using DEXA DICOM images without auto-generated regions.

Keywords: AUC, Correlation analysis, DEXA scan, diagnostic accuracy, osteoporosis.
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Behaviors of the Indian Peafowls (*Pavo cristatus*) affecting animal-induced accidents in the Southern Expressway, Sri Lanka

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The Indian peafowl (*Pavo cristatus*) is a major species causing animal-induced accidents in the Southern Expressways in Sri Lanka. A 30 km stretch of the Southern Expressway from Imaduwa to Aparekka interchange was used to examine the behaviors of peafowls and understand potential causes of accidents. Behaviors of individual peafowl were observed for a maximum of 30 minutes using focal animal sampling (n = 234 h). Scan sampling was conducted on peafowl groups (n = 36), with each group observed for 30 minutes in the morning, afternoon, and evening at 10-minute intervals. One-way ANOVA was carried out to compare behaviors within each period. Results indicated that walking was the main behavior observed (32.08 %) while flapping wings was the least (0.12%). Also, locomotory behavior (running, walking, and flying) is significantly higher in the morning ($F = 8.09$, $p = 0.001$) and evening ($F = 8.66$, $p = 0.001$). Walking was the most common behavior in the morning, however, perching was the most common in the afternoon. The Higher locomotory activity, especially walking across the expressway during peak traffic hours in the morning and evening, likely contributes to the higher frequency of accidents. Additionally, potential resting sites near the expressway during inactive periods, where peafowls engage in perching, sitting, and preening, may further encourage their activity near roadways. Therefore, making the bordering habitats less attractive to peafowls by modifying fences and consistent habitat management that reduces food availability and shelter near high-risk zones of the expressway may reduce the risk of collision.

Keywords: Behaviors, Indian Peafowl, Road collision, Southern expressway

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Effect of NaCl concentration on enzyme activities of halophilic bacteria in saltpans, Hambantota, Sri Lanka

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Halophilic bacteria are able to thrive in hypersaline environments and produce industrially important enzymes like amylases and proteases which can function under high salt concentrations. The present study aimed at screening of amylase and protease enzyme-producing bacteria, isolated from the sediments from the Hambantota saltpan. Screening of amylase and protease activity was performed on isolated bacteria (11 isolates). Bacterial cultures were inoculated on starch agar and skim milk agar to identify amylase and protease-producing bacteria respectively, and incubated at 37 ℃ for 48 hours. One strain showed positive results for both enzymes and was selected for quantitative analysis. Based on the morphological and biochemical characterization, it was identified tentatively as *Bacillus* spp. The Protease and the Amylase activity of the crude enzyme extract were determined under different NaCl concentrations by the Folin method and DNS (Dinitro-salicylic Acid) method respectively. Amylase activity was determined by growing the bacterium in starch broth with varying NaCl concentrations (1% to 10%) and the highest amylase activity (0.311 U/mL) was observed at 6% NaCl. The lowest activity (0.040 U/mL) was recorded at 1% NaCl. Similarly, protease activity was assessed by growing the bacterium in skim milk broth. The highest protease activity (0.097 U/mL) was detected at 2% NaCl, and the lowest (0.050 U/mL) at 6% NaCl. It highlights the potential of this strain to produce amylase and protease enzymes across a broad range of salt concentrations, making it suitable for industrial applications that use high salt concentrations. Future studies could optimize enzyme production for commercial applications.

Keywords: Amylase, Enzyme activity, Halophilic bacteria, Protease

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Safety practices and factors influencing the prevention of occupational hazards among nurses at Teaching Hospital Jaffna

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Nurses are known to be at the front line of risks and victims of occupational hazards among healthcare workers. Safety practices have been taken to reduce the hazards of the nurses in their workplace. This study aims to assess the safety practices and influencing factors to prevent occupational hazards among nurses at Teaching Hospital Jaffna, Sri Lanka. This hospital-based descriptive cross-sectional study was carried out among 410 nurses from May 2023 to August 2024. A stratified random sampling method was used with the exclusion criteria of administrative nurses, and nurses who are on maternity or any long-term leave. Data collection was done from July to August 2024 by using a validated self-administered questionnaire and analyzed by using SPSS 20. Respondent rate was 90.24% with the mean age (±SD) of 31.65 ± 4.943 years. Ratio between diploma and BSc holders were 3:1. Nearly 61.6% of them with working experience of less than five years. Among the 16 kinds of safety practices, nearly 63.0% of the participants had followed safety practices in moderate level, while 25.4% and 11.6% had followed in good and poor level, respectively. Mean score (±SD) for practice was 21.17 ± 4.505. Shortage of personal protective equipment (73.5%), non-flexible duty hours (71.6%), and inadequate training programs (53.8%) were mentioned by them as the most influencing factors for not following the safety practices. Religion (P=0.015) and educational qualification (P=0.011) were shown as having a significant association with safety practices. The study concluded that only 25.4% of nurses had good practices. Therefore, the practices must be improved by minimizing the influencing factors.

Keywords: Influencing factors, Nurses, Occupational hazards, Safety Practices

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Antimicrobial activity of SSRIs: Exploring their impact on gut microbiota using *Escherichia coli* as a model organism

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Selective serotonin reuptake inhibitors (SSRIs) are widely prescribed for depression to increase serotonin availability in the brain and improve mental health. However, emerging evidence suggests that SSRIs may also impact the gut microbiome, an essential component of the gut-brain axis. This study evaluated the antibacterial effects of six SSRIs, namely, fluoxetine, paroxetine, sertraline, fluvoxamine, citalopram, and escitalopram on *Escherichia coli* (ATCC 25922), chosen as a representative gut microorganism due to its well-characterized genome, ease of cultivation, and its role as a key facultative anaerobe in the human gut. Although *Escherichia coli* is not the dominant species in the gut, its response to SSRIs may provide insights into the potential broader effects of these drugs on gut microbial communities. The agar well diffusion method was used to assess inhibitory activity. Fluoxetine, paroxetine, sertraline, and fluvoxamine showed the strongest inhibition zones, ranging from 21 mm to 25 mm, while escitalopram and citalopram exhibited significantly lower activity with inhibition zones of 16 mm and 12 mm, respectively. Minimum Inhibitory Concentration (MIC) testing further confirmed this trend, with fluoxetine and paroxetine showing the lowest MIC values (78.12 µg/mL), while escitalopram and citalopram had much higher MICs (2500 µg/mL and 1250 µg/mL, respectively). Statistical analysis using the Kruskal-Wallis test revealed significant differences among the SSRIs ($p = 0.017$). These results suggest that fluoxetine and paroxetine possess stronger antimicrobial properties, while escitalopram and citalopram have weaker effects. Possible mechanisms for this antimicrobial activity could include disruption of microbial cell membranes or interference with metabolic pathways. It remains unclear whether these concentrations can be achieved in the gut during standard SSRI therapy. Given the importance of the gut microbiome in maintaining overall health, these findings raise concerns about the potential for SSRIs to disrupt microbial balance during long-term use. Further research, including clinical studies on patients undergoing prolonged SSRI therapy is needed to fully understand the implications of these drugs on gut microbial dynamics and overall health.

Keywords: Antimicrobial activity, Escherichia coli, gut-brain axis, gut microbiome, SSRIs

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Analysis of changes in the mean rainfall patterns in Sri Lanka

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In parallel with climate changes, understanding tropical rainfall dynamics becomes crucial for effective decision-making in agriculture, water management, and disaster preparedness. Sri Lanka, situated in the tropical Indian Ocean (IO), is particularly vulnerable to climatic shifts, especially concerning rainfall patterns. Despite this vulnerability, changes in mean rainfall remain underexplored, highlighting a critical research gap. The present study addressed this gap by examining shifts in mean precipitation in a warming climate context. The observational and reanalysis data (1990-2023) were analyzed to identify a midpoint marking a significant change in rainfall mean state, using statistical tests and sea surface temperature (SST) trends. This midpoint was then applied to analyze rainfall and associated climate mechanisms across Sri Lanka. Our analysis reveals a notable increase in mean rainfall after 2009. The changes in arid, dry, wet, and intermediate zones were 0.31, 0.74, 0.58, and 0.18 mm day^{-1} respectively. These increases are linked with large-scale ocean-atmosphere dynamics, including shifts in wind patterns, SST, moisture convergence, and vertical wind velocity. Specifically, the rise in SST in the IO and the resultant circulation patterns have enhanced moisture convergence, driving the observed rainfall increase from 2009 to 2023 compared to the preceding period. Our findings provide vital insights for shaping sustainable policies aligned with SDG 13 on climate action.

Keywords: Climatic zones, Indian Ocean region, Rainfall mean state

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A comprehensive analysis of the ingredients used in the 'Kesharanjana' formulations compiled from 'Thalpathe Piliyam' book series

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Premature greying of hair is a frequently reported problem. Although there are many solutions there is no effective and harmless solution for this problem. In Ayurveda, 'Kesharanjana' has been mentioned to restore the natural color of the hair. In the Sri Lankan traditional system of medicine, many formulae have been mentioned to restore hair color. Hence this study was aimed to study the pharmacodynamic properties of the commonly used herbal plants of formulae mentioned in 'Thalpathe Piliyam' book series for 'Kesharanjana'. Formulae mentioned for 'Kesharanjana' were gathered from 'Thalpathe Piliyam' and commonly mentioned herbal plants were analyzed with its pharmacodynamic properties. Twenty-two formulae were mentioned in 'Thalpathe Piliyam' as 'Kesharanjana'. Among them, 60% out of 22 formulae were mentioned as 'Shirolepa' (paste). Out of 22 formulae, 'Keekiridiya' (*Eclipta prostrata*) 72.72%, 'Bulu' (*Terminalia bellerica*) 36.36%, 'Thala' (*Sesamum indicum*) 36.36%, 'Velmee' (*Glycyrrhiza glabra*) 40.90%, 'Iriveriya' (*Plectranthus zatarhendi*) 22.72%, 'Vetake Aralu' (*Pandanus kaida*) 22.72%, 'Aralu' (*Terminalia chebula)* 31.81%, 'Nelli' (*Phylanthus emblica*) 36.36%, 'Mukunuwenna' (*Alternanthera sessilis*) 18.18%, 'Erandu' (*Ricinus communis*) 13.63%, 'Suduhandun' (*Santalum album*) 13.63%, 'Higurupiyaliya' (*Kaempferia galanga*) 13.63%, 'Suwanda Kottam' (*Saussarea lappa*) 13.63%, 'Kuppamenia' (*Acalypha indica*) 13.63% were the most commonly mentioned 14 plants. Considering the pharmacodynamic properties, the commonly used 14 plants have 'Vata Pitta Shamaka' action. According to the Ayurveda, grey hair occurs due to the 'Pitta Dosha' combined with vitiated 'Vata Dosha'. Hence the 22 formulae mentioned in *Thalpathe Piliyam* can be used for grey hair as 'Kesharanjana'.

Keywords: Grey Hair, Kesharanjana, Palithya, Natural Hair Dye

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Harnessing *Utricularia gibba* (Family: Lentibulariaceae) as a biological control method for dengue vector mosquito larvae

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The carnivorous plant genus *Utricularia* includes aquatic species capable of trapping a diverse range of prey, often leading to prey mortality due to anoxia. This study experimentally evaluated the predatory potential of *U. gibba* (humped bladderwort) on the larval and pupal stages of *Aedes albopictus*; a secondary dengue vector in Sri Lanka. Eggs of *Ae. albopictus* were reared to obtain the larval stages in the Entomology Laboratory, Department of Zoology, University of Ruhuna, Sri Lanka, under a 12 h:12 h photoperiod. Larvae were fed daily with finely ground, sieved fish food. *Utricularia gibba* samples were collected from paddy fields in Ginnaliya, Sri Lanka, and identified using standard field guides. Shoots containing 20 bladderwort traps were placed in plastic cups with 75 ml of dechlorinated water. Fifty larvae or pupae were introduced into separate cups, with ten replicates per stage. Control experiments were conducted without plant shoots. Daily predation rates were recorded and analyzed using SPSS and Minitab (v. 21) software. *Utricularia gibba* exhibited significant predatory activity against all developmental stages of *Ae. albopictus*. Within 24 hours, predation rates were as: 74.36% (34.08 ± 5.05) for 1st instars, 70.73% (32.42 ± 4.97) for 2nd instars, 29.45% (13.50 ± 3.30) for 3rd instars, 6.73% (3.08 ± 0.60) for 4th instars, 0.18% (0.08 ± 0.08) for pupae and control with no mortality. Predation rates significantly increased across developmental stages ($p<0.05$), with higher predation observed in early larval stages (1st and 2nd instars) compared to later stages and the pupae. The high predation efficiency of *U. gibba*, particularly in early larval stages suggests its potential as a biocontrol agent for *Ae. albopictus* in natural habitats. The plant's facultative predation behavior further supports its suitability for integration into sustainable vector management strategies.

Keywords: Aedes albopictus, aquatic carnivorous plant, biological control, bladderworts, dengue vectors

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AI for monitoring urban growth and its effects on green spaces and biodiversity: Focus on Sri Lanka

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Urban expansion in Sri Lanka has led to a significant reduction in green spaces and a corresponding threat to biodiversity, impacting the country's ecological balance and long-term sustainability. This study integrates Artificial Intelligence (AI) for monitoring urban growth patterns and assessing their impacts on green spaces and biodiversity within Colombo and other rapidly urbanizing regions in Sri Lanka. A combination of remote sensing, machine learning algorithms, and Geographic Information System (GIS) tools is utilized to identify changes in land cover and the degree of fragmentation of natural habitats over the past decade. It employs a mixed research methodology by employing satellite imagery and AI models to detect urban sprawl, quantify the loss of green areas, and highlight zones of critical ecological importance. Results indicate a 35% reduction in green spaces within the urban peripheries, contributing to biodiversity loss, increased carbon emissions, and disrupted hydrological cycles. The AI model's predictive capabilities identified at-risk zones before significant ecological damage occurred. The study proposes implementing a nature-based urban planning approach, leveraging AI for continuous monitoring, and enforcing stringent land-use policies, including green corridor development and biodiversity buffer zones. By integrating AI-driven insights with urban planning, this research provides a sustainable approach to addressing the ecological impacts of urbanization. The findings underscore the urgent need for a balanced urban development strategy that conserves biodiversity, promotes sustainable city growth, and provides a replicable framework for other developing nations facing similar challenges, ensuring that urban expansion does not come at the expense of environmental health.

Key words: Artificial Intelligence, Biodiversity, Green Spaces, Sustainability, Urban Expansion
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A novel technique to identify Shoulder Impingement Syndrome (SIS) using MRI

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The shoulder, considered the most mobile joint in the body, ranks third among the most common musculoskeletal complaints. Shoulder Impingement Syndrome (SIS) displays as anterior shoulder pain, particularly during overhead activities. Clinical diagnosis of SIS typically depends on physical examination, enhanced by Magnetic Resonance Imaging (MRI), X-rays, or ultrasonography. While MRI is good at detecting various soft tissue and bony abnormalities associated with SIS, subjective interpretation may lead to misdiagnosis and misclassification due to human errors. This study proposes a novel technique for SIS identification, using texture features extracted from supraspinatus tendon MRI. Utilising a prospective study design and a dataset of 12 subjects from Sri Jayewardenepura General Hospital, a tertiary care hospital in Western Province Sri Lanka, several Machine Learning (ML) models were trained using 80% of both original and augmented datasets with varying numbers of texture features. Cross-validation was conducted on all feature sets, and the Random Forest Classifier (RFC) algorithm, yielding the highest cross-validation mean score, was chosen as the optimal algorithm. Finally, a successful ML model was developed using the RFC algorithm to identify SIS using fourteen texture features of SST MRI with 75% accuracy.

Keywords: GLCM, MRI, Machine Learning, Random Forest Classifier, Shoulder Impingement Syndrome

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Optimization and performance evaluation of dye-sensitized solar cells using cockscomb flower extract as a natural sensitizer

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Dye-sensitized solar cells (DSSCs) have gained significant interest due to the increasing global demand for sustainable and renewable energy. The use of natural dyes as sensitizers in DSSCs is becoming more popular due to their numerous advantages, including easy availability, non-hazardous nature, and relatively lower costs compared to synthetic dyes. This research focuses on the use of cockscomb flower (*Celosia Cristata*) extract, which contains anthocyanin and betacyanin pigments, as a natural sensitizer for DSSCs to enhance device efficiency while optimizing the dye absorption time. DSSCs were fabricated using a nanocrystalline TiO_2 layer deposited on fluorine-doped tin oxide (FTO) glass via the doctor-blade technique, then sensitized with the cockscomb flower extract. UV-visible spectroscopy analysis of the dye extract showed an absorption peak in the 500-600 nm range, attributed to anthocyanin, betacyanin, or a combination of both. The effects of varying the dye absorption time on the photovoltaic performance were studied and optimized. Key device parameters, including Open Circuit Voltage (V_{OC}), short Circuit Current Density (J_{SC}), Fill Factor (FF), and Efficiency (η) were measured. The highest efficiency of 0.25% was achieved with a photoanode that had been immersed in the dye for 1 hour. The obtained experimental data indicate that the dye extract from the cockscomb flower achieved a photoelectric conversion efficiency of up to 0.25%, with a V_{OC} of 0.55 V, and J_{SC} of 0.88 mA/cm^2.

Keywords: Dye-sensitized solar cell, Natural Dye, Photoanode, Photosensitizer, Photovoltaic characteristics

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Purification and surface modification of anode materials from spent Li-ion batteries as a recycling approach

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Rechargeable lithium-ion batteries (LIBs) are still considered as the state-of-the-art of the energy storage technology. However, extensive usage together with continues increase in the demand for LIBs, it poses significant environmental issues in disposal without proper recycling. The anode, typically made of synthetic or treated natural graphite, directly affects the total battery cost. Further, graphite is emerging as a critical material for secondary battery applications with a 10% annual increment in demand. Hence, this study aims to recycle the anode materials from spent LIBs as a potential battery-grade anode material. Initially, spent anode materials (SAMs) were separated from selected discarded LIBs. Fine Powder of SAM with particle size >53 μm, was purified with 5% (v/v) HCl at 60° C for 75 minutes, followed by surface modification with 69% HNO_3 at 60 °C for 8 hours, respectively. Carbon content analysis (ASTM 561-C) showed a significant purity enhancement from 93.24% to 99.78%. X-ray diffraction and Raman spectroscopic analysis confirmed the existing of highly crystalline nature in SAMs with low crystalline defects. It also evidences for the preserving of the required crystalline phase during both chemical treatments. Fourier transform infrared analysis evidences for the successful surface modification, through introducing oxygen-based functional groups that could eventually facilitate the formation of favorable solid-electrolyte interface during battery cycling. Therefore, purified and surface-modified anode materials from spent LIBs are a promising substitute for battery-grade graphite, offering sustainable solutions for adverse environmental issues, and resource scarcity together with economic benefits.

Keywords: Anode material, Purification, Recycling, Spent Li-ion batteries, Surface modification

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Fabrication of writable and printable superhydrophobic paper via dip-coated silica-based treatment

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The development of superhydrophobic, printable, and writable cellulosic paper is increasingly important for various applications. Superhydrophobic cellulosic paper is a sustainable, biodegradable alternative to plastic, reducing plastic waste and offering enhanced water resistance, making it an eco-friendly solution. This study presents a straightforward and effective method for fabricating superhydrophobic paper that retains water-repellent properties while allowing printing and writing. The paper is coated with modified silica using tetraethyl orthosilicate, methyltriethoxysilane, and 1H, 1H, 2H, 2H-perfluorooctyltriethoxysilane via a dip coating process. The resulting multi-layered structure of SiO_2 microbeads, featuring nano-micro structured, mountain-like wrinkled coatings, achieves an impressive water contact angle of 152°±2°. Remarkably, the superhydrophobic surface maintains its properties even after 50 abrasion cycles on sandpaper and exhibits self-cleaning capabilities against soil particles and various liquids. Furthermore, the treated paper demonstrates a tensile strength of approximately 6 MPa, compared to 2 MPa for untreated paper, while retaining superhydrophobicity across a pH range of 5 to 11. Compared to conventional superhydrophobic paper-making methods, the novel approach offers both printability and writability, while effectively maintaining its superhydrophobic properties.

Keywords: 1H,1H,2H,2H-perfluorooctyltriethoxysilane , Methyltriethoxysilane Superhydrophobic paper, Tetraethyl orthosilicate

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Effects of partial replacement of commercial carbon black by recovered carbon black (rcb) in rubber compounding

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The use of carbon black as a reinforcing filler in tire production plays a vital role in improving the durability and performance of tires; nonetheless, its manufacturing process presents environmental challenges related to carbon dioxide emissions and the depletion of natural gas resources. The purpose of this investigation is to explore the effects of optimum percentage of physically upgraded recovered carbon black (rCB) that can be utilized in tyre tread compounding as a blend with commercial carbon black (cCB). This study demonstrates a series of compounding tests with replacing cCB as a varied percentage of recovered carbon black (rCB) loading since 100% replacement of cCB showed lower physical and mechanical properties in rubber compounding. Rheological properties and physico-mechanical properties such as abrasion volume loss, tear resistance, tensile properties, density, and hardness of tire tread layer compounds were examined. The findings revealed that the physico-mechanical properties have been improved when rCB loading is raised (10% to 20%) and reduced gradually after further addition (at 30%). An attempt to prepare agglomerates of rCB using starch (1% solution) as a binding agent was successful in handling the puffy nature of rCB however, the final physico-mechanical properties were degraded slightly. The best properties were observed when the optimum rCB loading was 20 % in tread compounds. Based on these results, it could be concluded that the partial replacement of commercial carbon black (cCB) by rCB in tire tread compounds would be attractive to handle unusable rCB generated in waste tire pyrolysis plants.

Keywords: Carbon black, recovered carbon, performance evaluation, sustainability, tire compounding

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Effects of tin (II) chloride ($SnCl_2$) exposure on oxidation and interactions with the functional groups of hemoglobin

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$SnCl_2$ is one of the common inorganic forms of tin used in industry. 5-100 $\mu molL^{-1}$ levels of inorganic tin have been reported in human circulation. Even though erythrocytes are a principal target of tin in human circulation, its physiological consequences are poorly addressed. Therefore, this study was aimed at elucidating the physiological impact of inorganic tin exposure on human erythrocytes by assessing hemoglobin oxidation and binding to hemoglobin. Following the informed voluntary consent, venous blood was collected from ten females and then 10% hematocrit of RBC was prepared using 0.9% physiological saline. Erythrocytes were treated with different $SnCl_2$ concentrations (10, 50 and 100 $\mu molL^{-1}$), positive and negative control treatments. The samples were incubated at 37 ^{0}C for 24 hours in triplicates. Absorbance of methemoglobin was measured at 630 nm and 700 nm using UV-Visible spectrophotometer. Absorbance at 211, 277 and 406 nm was measured to investigate the interaction of Sn^{2+} with peptide, aromatic amino acid and heme groups of hemoglobin. According to the results, there was no significant difference between the hemoglobin oxidation as measured by methemoglobin levels under different $SnCl_2$ and control treatments (One-way ANOVA, $p>0.05$). Furthermore, there was no significant difference between the mean absorbance at 211, 277 and 406 nm following $SnCl_2$ treatments (One-way ANOVA, $p>0.05$). This indicates that there is no significant binding of Sn^{2+} to these biochemical groups in hemoglobin up to 100 $\mu molL^{-1}$ $SnCl_2$. In conclusion, exposure to Sn^{2+} in the concentration range 0-100 $\mu molL^{-1}$ does not significantly affect the function of hemoglobin in human erythrocytes.

Keywords: Binding, Erythrocytes, Hemoglobin, Methemoglobin, Spectrophotometer, UV-Visible

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Investigating dye adsorptive ability of post-modified rice husk-based biochar-iron oxide nanocomposites

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In recent years, nanocomposite-based materials are widely studied for various applications. This specific study focused on synthesizing post-modified rice husk based- biochar-iron oxide nanocomposites using two different approaches; an iron extract-based modified biochar (EMBC) nanocomposite and iron salt-based modified biochar (SMBC) nanocomposite. They were then investigated for their ability on adsorbing a common textile dye, methylene blue (MB). The EMBC was synthesized by using an acid leachate of a red clay sample, while SMBC was synthesized by utilizing a Fe^{2+}/Fe^{3+} mixture. FTIR and XRD analysis suggested the formation of biochar-Fe_3O_4 (BC-Fe_3O_4) composites. The average Fe_3O_4 crystallite size of 13.46 nm suggested that the BC surface prevents the agglomeration during the formation of these nanocomposites. The dye adsorption efficiency of both EMBC and SMBC nanocomposites were analyzed using an aqueous MB solution and compared with that of pristine BC. Batch sorption and kinetic studies were performed by optimizing different reaction conditions such as, MB dye concentration (100 mg/L), pH (10), and equilibrium time (2 hours). Based on the results obtained, both EMBC and SMBC exhibited adsorption capacities of 35.15 mg/g and 35.08 mg/g, respectively. Interestingly, these capacities are significantly higher than that of BC (10.09 mg/g). Kinetic studies indicated that both EMBC and SMBC followed pseudo second order kinetic model with R^2 values of 0.969 and 0.959, respectively. Results suggest that incorporation of Fe_3O_4 to the BC surface strengthens the interactions between adsorbates and adsorbent. Overall, this study shows that these BC-Fe_3O_4 nanocomposites have the ability to act as potential environmental remediating tool by removing certain textile dye contaminants from wastewater.

Keywords: adsorption, Iron oxide, modified biochar, methylene blue, nanocomposite

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Spatiotemporal variation of microplastics in coastal ecosystems: A case study in Rekawa lagoon

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Microplastics (MPs) have been studied across coastal waters as they impact on ecological integrity of those sensitive ecosystems. Under this context, spatiotemporal variability of MPs level is a potential confounding factor to be concerned. The present study describes short-term spatiotemporal variability of MPs distribution in water and sediments, and selected fish species in Rekawa lagoon, Sri Lanka. Samples were collected in three occasions from November 2023 to January 2024 selecting eight locations of the lagoon. Water samples were collected using a plankton net (30 µm), while sediment samples were collected using a PVC Corer. Five different edible fish species were collected from the commercial catch. Density separation was performed using 1.2 g/cm^3 NaCl solution followed by digestion with 30% H_2O_2. Fish samples were digested with 10% KOH at 60 ℃. The polymer type and the level of degradation were identified using FTIR spectroscopy. The highest MPs concentrations of sediment (80.00±26.45 items/kg) and water (0.50±0.19 items/L) were recorded in December, whereas the lowest values were found in January for sediment (56.66±15.27 items/kg) and water (0.24±0.17 items/L). The MPs concentration in fish species ranged from 1-4 items/individual in guts and gills. The heavy rain and excessive riverine influx might have carried plastic debris to the lagoon in December. Fiber was the most prevalent plastic type collected from water, sediment, and fish species and most of them were <1mm in size. Polyethylene, polypropylene and polyester were the major polymer types and most of them were partially degraded. Further, it emphasizes the need for further research towards the accumulation of MPs in coastal ecosystems and their toxicity on human.

Keywords: Microplastics, Pollution, Polymers, Spatiotemporal variability, Southern coast

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Computational study of linear and nonlinear optical properties of ruthenium alkynyl spiropyran complexes

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Molecular switches have gained significant attention in recent years due to the potential applications in molecular electronics and photonics. While most switches are limited to two states, the systems that can switch between multiple stable states could be used for high-order logic functions. Density functional theory (CAM-B3LYP/6-31G(d)/LANL2DZ) calculations have been undertaken herein to investigate switchable second-order nonlinear optical properties of the recently synthesized ruthenium σ-alkynyl complexes bearing a photochromic spiropyran (SP) bridge of the type ((Cp^*)Ru(dppe)(C≡C-SP-NO_2)). The structural parameters of the model Ru complexes are in good agreement with the available X-ray data. The calculated Bond Length Alternation (BLA) values of the merocyanine open-ring forms are reasonably smaller than that of the spiropyran complexes due to enhanced π-conjugation in the former. The static first hyperpolarizability (β_{tot}) calculations showed that the open-ring form is more NLO-active than the close-ring structure, which can be attributed to the better π-conjugation and lower BLA value of the merocyanine structures. The incorporation of the ligated Ru to the nitro-substituted ethynylspiropyran ligand causes an increase in β_{tot} due to the strong electron-donating capability of the metal. Both the ring-opening process and metal coordination lead to a decrease in the HOMO-LUMO energy gap, and therefore a large β_{tot}. The effect of one-electron oxidation of the spiropyran complex on its NLO properties was assessed. A large change in β_{tot} was predicted, particularly for the oxidized form of the open-ring complex. The Ru complexes appear not to undergo metal-centered oxidation, instead, spin densities and molecular orbitals showed that the electron is lost from an orbital delocalized through the Ru-C≡C- group. The TDDFT results showed that the main optical band is red-shifted upon the ring-open process and a positive correlation between β_{tot} and the wavelength was found. For this novel Ru alkynyl system, the computed linear and second-order NLO properties exhibit tunability through both oxidation of the Ru alkynyl moiety and spiropyran ligand photoisomerization.

Keywords: Density Functional Theory, Molecular Switches, NLO properties, Spiropyran complexes

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Synthesis of graphene oxide, graphitic carbon nitride and iron oxide (GO/ g- C_3N_4/ Fe_2O_3) nanocomposite for textile dye (RB 5) degradation

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Textile dyes, owing to their inherent resistance to biodegradation pose a substantial challenge to wastewater management, leading to significant environmental contamination of aquatic ecosystems. The present study was undertaken to investigate photocatalytic degradation of reactive black-5 (RB5) using GO/ g-C_3N_4/ Fe_3O_4 nanocomposite as a catalyst. Graphene oxide (GO), g-C_3N_4 and Fe_2O_3 were synthesized by modified hummer's method via graphite, thermal polycondensation method using urea and chemical precipitation method from $FeCl_3.6H_2O$, respectively. Ternary nanocomposite was prepared by mixing and stirring each nanoparticle and characterized by using uv-visible and FTIR spectrophotometry. UV-Vis spectra exhibited maximum absorption at 230 nm for GO, 327 nm for g-C_3N_4, 380 nm for α-Fe_2O_3, and 323 nm for the GO/g-C_3N_4/Fe_2O_3 composite. Characteristic FTIR peaks for GO were observed at 1716 cm^{-1} (C=O stretch), 1620 cm^{-1} (C=C stretch) and for for g-C_3N_4 at 1326 cm^{-1} (C–N) and1635 cm^{-1} (C=N stretching) and for hematite at 562 and 504 cm^{-1} Fe–O vibrations. A wide peak at about 3000 cm^{-1} and a peak at 1565 cm^{-1} were observed for the GO/g-C_3N_4/Fe_2O_3 ternary nanocomposite. Photocatalytic degradation of RB 5 under sunlight using the catalyst (GO/ g-C_3N_4 /Fe_3O_4 1: 95: 5), with the initial concentration of dye (40 ppm), catalytic dosage (2 g/L), and pH (4) resulted 99.4% degredation efficiency. The dye degradation percentage of catalyst remained was close to 100% even after 5 cycles. Scavenger activity was observed with Na_2EDTA, p-benzoquinone, iso propanol alcohol and tert-butanol. It was found that superoxide radicals were involved in the degradation mechanism

Key words: Graphene oxide, Graphitic Carbon Nitride, Iron oxide, Nanocomposites, Photocatalytic degradation

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Investigation of reusability and adsorption isotherms of KOH-activated Tire pyrolysis char for the removal of aqueous Cu^{2+} and Pb^{2+} ions

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The value addition of tire pyrolysis char (TPC) has gained increasing attention as the disposal of TPC remains problematic, even though the pyrolysis of waste tires is considered a viable solution for the end-of-life tires. As a value addition to this waste, TPC based activated carbon (ATPC) was prepared by heating TPC with 1:4 (w/w) KOH in nitrogen atmosphere at 750 ºC for 1 hour. The excess KOH was removed by washing with deionized water. The absorption of Cu^{2+} and Pb^{2+} ions by ATPC in 500, 1000, 1500, 2000 and 2500 ppm solutions were investigated at pH 7 by Atomic Absorption Spectrophotometry. The highest adsorption capacities for Cu^{2+} & Pb^{2+} were reported as 201.80 and 127.70 mg g^{-1} respectively at 2000 and 2500 ppm solutions when 0.20 g of ATPC was stirred for 2 hours at 200 rpm. When the amount of absorbents was increased from 0.20 to 0.60 g, adsorption capacities were reduced for both metal ion solutions though Cu^{2+} & Pb^{2+} metal ion removing efficiencies increased. The desorption of the adsorbed metal ions were investigated in 2 M HCl and the highest desorption rates for Cu^{2+} and Pb^{2+} were obtained as 4.1% and 61 % respectively. Therefore 2 M HCl can be considered as an efficient eluent for the recovery of Pb^{2+} ions removed from the waste waters contaminated with Pb^{2+} ions. According to the isotherm modeling data, Langmuir model (R^2= 0.944) is best fitted for Cu^{2+} implying monolayer adsorption. Freundlich model (R^2 = 0.946) is best fitted for the removal of Pb^{2+} suggesting multilayer adsorption has taken place. Maximum adsorption capacities estimated by Langmuir isotherm for Cu^{2+} and Pb^{2+} were 204.90 and 121.90 mg g^{-1} respectively while Freundlich K_F values for Cu^{2+} and Pb^{2+} were recorded as 60.30 and 1.42 mg g^{-1} respectively.

Key words: Adsorption, Carbonized char, Reusability, Tire derived Activated Carbon, Tire pyrolysis char

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Seasonal variations in sugar and phenolic content of black tea (*Camellia sinensis* L.) in high-grown regions in Sri Lanka

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Tea (*Camellia sinensis* L.) grown in seven regions of Sri Lanka is divided into high, mid, and low altitudes. The naturally occurring sugars and total phenolic content (TPC) in black teas produced with seasonal effect play a crucial role in determining its taste and quality. This study aims to evaluate the impact of seasonal variations on the sugar content and TPC of black tea from different high-grown regions in Sri Lanka. Sugars (fructose, glucose, sucrose) and TPC were analyzed using High Performance Liquid Chromatography (HPLC) and the Folin-Ciocalteu method, respectively. Dry weight for HPLC was measured using ISO 1572-1980 standards. For TPC analysis, gallic acid was used as the standard. Sensory analysis was performed to assess the taste and aroma of both seasonal & off-season teas. The results showed that fructose and glucose levels increased during the season for *Dimbula* (8.95 ± 1.23^{c} and $9.83\pm1.38b^{c}$) & *Uva* teas (11.76 ± 1.28^{a} and 13.89 ± 3.42^{a}) compared to the off-season (*Dimbula*:7.89 ± 0.34^{c} and 8.29 ± 1.19^{dc}, *Uva*:10.76 ± 2.2^{ab} and 11.20 ± 3.17^{ab}). In contrast, these sugars decreased during the season in *Udupussellawa* (9.17 ± 0.57^{bc} and 11.65 ± 1.58^{a}) and *N'Eliya* (4.62 ± 0.68^{d} and 6.87 ± 2.68^{d}) versus their off-season (*Udupussellawa:*10.93 ± 0.51^{a} and 13.14 ± 2.06^{a}, *N'Eliya*:5.49 ± 1.08^{d} and 7.57 ± 2.6^{dc}) respectively. Sucrose content and TPC were significantly higher across all regions in season (*Dimbula*:26.71 ± 3.95^{bc} and 70.87 ± 2.46^{a}; *Uva*:16.30 ± 1.55^{ef} and 66.67 ± 2.52^{bc}, *Udupussellawa*:23.56 ± 3.92^{cd} and 65.95 ± 3.9^{bc}; *N'Eliya*:38.58 ± 2.07^{a} and 71.19 ± 10.5^{a}) than in the off-season (*Dimbula*:17.99 ± 3.32^{e} and 66.6 ± 0.93^{bc}, *Uva*:12.07±2.44f and 63.81 ± 2.32^{c}, *Udupussellawa*:19.47 ± 3.31^{ed} and 64.13 ± 3.75^{c}; *N'Eliya*:29.58±1.78b and 69.72 ± 4.78^{ab}) respectively. Sensory evaluation showed that seasonal teas had better quality characteristics compared to off-season. Thus, it is evident that seasonal variations in high grown teas have a positive correlation with sugar content and TPC.

Keywords: dimbula, high grown, liquor quality, seasonal tea

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Impact of solvent-solvent partitioning on polyphenol content, antioxidant and anti-inflammatory activities of aqueous wood extract of *Cedrela toona*

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Wood waste, a byproduct of the timber industry, contains various bioactive compounds, including polyphenols. This study examines the impact of solvent-solvent partitioning (SSP) on polyphenols and its bioactivities including antioxidant and anti-inflammatory activities of a polyphenol-rich source, a wood waste extract of *Cedrela toona* to understand the interactions and synergies between bioactive compounds during purification. The aqueous wood extract (AWE) of *Cedrela toona* was subjected to ultrasound assisted extraction using distilled water as a solvent. The conventional SSP process was carried out with AWE with hexane to remove non-polar substances that mask the presence of these bioactive compounds. Before and after SSP, AWE was evaluated for total polyphenol content (TPC) using the Folin-Ciocalteu method, and total flavonoid content (TFC) using the aluminum chloride method. The invitro antioxidant activity was assessed using the DPPH free radical scavenging assay and anti-inflammatory activity was evaluated using protein egg albumin denaturation assay while serving Trolox and Diclofenac Sodium as the positive controls respectively. Before SSP, the extract had a TPC of (16.52±0.71 mg GAE/g) and TFC of (10.67±0.28 mg QE/g), which increased up to (27.19±0.18 mg GAE/g) and (16.40±0.76 mg QE/g) respectively with the removal of non-polar substances like terpenoids and fatty acids. Before SSP, the antioxidant activity had an IC_{50} of (10.98±0.41 µg/mL), which increased up to (17.45±0.45 µg/mL) after SSP, indicating a reduction in antioxidant potency. Similarly, the anti-inflammatory activity, with an IC_{50} of (248.95±2.9 µg/mL), was reduced to an IC_{50} of (572.03±2.9 µg/mL) after SSP. The reductions indicate that non-polyphenolic compounds in the crude extract may synergistically enhance bioactivities while highlighting the complex interactions between compounds during purification processes. The findings could improve methods for isolating polyphenols and bioactive compounds, aiding the development of polyphenol-rich extracts for pharmaceuticals and nutraceuticals.

Keywords: Antioxidant, Anti-inflammatory, Polyphenols, Solvent-Solvent Partitioning,

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Utilizing crude rice bran lipase immobilized in alginate extracted from *Sargassum ilicifolium* for biodiesel production

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Enzymes are widely used in industries including food, textile, pharmaceutical and biofuel due to their specificity and efficiency under mild conditions. However, their applicability is limited by instability, short lifespan, and challenges in large- scale recovery. This study evaluated the effect of immobilizing lipase in alginate beads on biodiesel production using virgin coconut oil as the substrate. Lipase enzyme and alginate were extracted from rice milling by- products and *Sargassum ilicifolium*, respectively. FT-IR analysis of alginate extracted using formaldehyde (Method B) showed major peaks at 3452 cm^{-1} (O-H stretching), 1600 cm^{-1} (C=O stretching), and 1013.36 cm^{-1} (C-O stretching), closely matching pure sodium alginate. The Lowry assay detected the protein content of crude rice bran lipase as 6.07 $mgmL^{-1}$. Alginate beads were prepared in four different ratios of alginate-to-crude rice bran lipase (1:0.5, 1:1, 1:1.5, 1:4) and stored at 4 °C. Hydrolytic activity was assessed using coconut oil/PVA as a substrate, with the 1:4 ratio showed the highest activity (0.2341 U). Biodiesel is produced through transesterification, where triglycerides react with alcohol in the presence of a catalyst. This was evaluated against alkali-alcohol and free crude lipase methods. Yield of biodiesel, glycerol and density were 49.19%, 26.37%, and 0.743 kg/m^3, respectively, with a higher saponification value (111.41 mg KOH/g) and smoke point (230 °C) compared to the other methods. The use of alginate as a polymer substrate provides a sustainable approach for enzyme reuse in industrial applications. Future studies should focus on optimizing alginate and purification techniques for the reusability of these beads.

Keywords: Alginate, Immobilization, Hydrolysis activity, Rice bran lipase, Sargassum ilicifolium,

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Preparation of secondary metabolites rich extract of *Atalantia ceylanica* (Yakinaram) leaves and investigation of some pharmacological properties to transform it into value-added products

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Atalantia ceylanica (locally known as Yakinaram) is a plant belonging to the family Rutaceae with a high medicinal value. The decoction of *A. ceylanica* leaves is known to be used for the treatment of liver ailments, inflammations in the respiratory system and diabetes in Ayurvedic medicine. Despite the well-known claims in Ayurveda use of the plant in value addition is unexplored, making it an underutilized plant in the Sri Lankan context. Therefore, the objective of this work is to investigate the phytochemical profiles and pharmacological properties of leaf extracts from *A. ceylanica*, to transform them into value-added products. Leaves of *A. ceylanica* were collected from Ganegoda, Sri Lanka and aqueous extracts were prepared using Soxhlet, reflux and decoction methods. Qualitative phytochemical screening for aqueous extracts of *A. ceylanica* was carried out followed by the quantification analysis for alkaloids, flavonoids and phenols. DPPH assay was carried out to check the anti-oxidant capacity. A brine shrimp assay was performed to analyze general cytotoxicity. Glucose uptake analysis was carried out by in-vitro glucose uptake by yeast cells assay. Yakinaram green tea was formulated as value added product which 2.0g of dried ground leaves of *A.ceylanica* per tea bag accordance to the preference of consumers. It was found that the aqueous extract of *A. ceylanica* was rich with phytochemicals with 0.33% alkaloids, 0.42% flavonoids, 0.22% phenols and antioxidant properties shown with IC50 value 2.1 mg/mL. Brine Shrimp Assay shown that decoction was nontoxic with LC50 value 230 ppm. From glucose uptake assay, an increase in the weight of the aqueous extract corresponded to a higher percentage of glucose uptake by yeast cells. In conclusion, the aqueous extract of *A. ceylanica* is a rich source of phytochemicals. When incorporated into green tea as a value-added product, it can provide significant pharmacological properties.

Keywords: Atalantia ceylanica, antioxidants, anti-diabetic, cytotoxicity

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Evaluation of antioxidant and sunscreen activities of hydromethanolic extract from *L. acidissima* bark and its herbal sunscreen gel

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Limonia acidissima (Wood Apple) is a fruit plant in Southeast Asian countries. It belongs to the same family of Thanaka whose bark paste is effectively used in traditional cosmeceutical preparations in Myanmar. The aim of this study was to evaluate the antioxidant and sunscreen activities of the hydromethanolic extract of the *Limonia acidissima* bark and to formulate an herbal sunscreen gel. Ultrasound-assisted extraction of dry bark powder using 80% methanol gave a 3% yield. Phytochemical screening of the extract revealed the presence of phenols, flavonoids, alkaloids, and tannins. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay was conducted against the standard ascorbic acid using the 96-well plate reader to evaluate the antioxidant activity of the bark extract. DPPH assay gave moderate scavenging activity (SA_{50} value of 284.4 ± 6.0 ppm.) compared to the positive control, ascorbic acid (SA_{50} value 28.1 ± 0.1 ppm. In-vitro sunscreen activity was evaluated in terms of SPF using Mansur's equation on a concentration series in methanol. The 2 mg mL^{-1} of the extract exhibited a very high SPF value of 35.8 ± 0.1, confirming it has the potential to be formulated as a herbal sunscreen gel with promising antioxidant activity. The herbal sunscreen gel, formulated with 2.5% freeze-dried bark extract, was tested for appearance, pH (5.8–6.2), viscosity (4500–5000 cP), spreadability (820 - 840 g cm s^{-1}), and microbial purity. Results showed a uniform appearance, optimal spreadability, and no microbial contamination, with all parameters remaining stable throughout the testing period, supporting its potential as a commercial product.

Keywords: Antioxidant, herbal sunscreen, Limonia acidissima, phytochemical analysis, sun protection factor (SPF)

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Effects of *p*-hydroxybenzoic acid, *p*-aminobenzoic acid and salicylic acid on calcium oxalate crystal formation in synthetic urine

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Identifying active components to dissolve kidney stones is crucial for avoiding painful surgeries and reducing the high costs associated with traditional treatment methods. This study focuses on evaluating the inhibition effect of *p*-Hydroxybenzoic Acid (PHBA), *p*-Aminobenzoic Acid (PABA) and Salicylic Acid (SA) on calcium oxalate crystal formation under synthetic urine conditions. Crystals were harvested in the presence and absence of PHBA, PABA and SA at high supersaturated levels of $CaCl_2$ and $Na_2C_2O_4$ solutions in synthetic urine. The results showed that all acids were effective in reducing the Calcium Oxalate crystal yield (~1% to ~30% by mass). Furthermore, different Calcium Oxalate crystal morphologies were observed under a light microscope at various $Ca^{2+}/C_2O_4^{2-}$ ratios and further characterizations were completed using FT-IR and Zeta Potential measurements. In the presence of PHBA, at low concentrations of Ca^{2+}($Ca^{2+}/C_2O_4^{2-}$ =1/20), square-shaped Calcium Oxalate Dihydrate (COD) crystals were formed and at high concentrations of Ca^{2+}($Ca^{2+}/C_2O_4^{2-}$ =20/1), crystals were purely 100% COD. In the presence of PABA, at a high Ca^{2+} ratio, mixtures of calcium oxalates, Calcium Oxalate Monohydrate (COM), COD and Calcium Oxalate(COT) were formed and at low concentrations of Ca^{2+}($Ca^{2+}/C_2O_4^{2-}$ =1/20), regular rod shape COM and flower shape COM aggregates were produced. In the presence of SA, at high concentrations of Ca^{2+}($Ca^{2+}/C_2O_4^{2-}$ =20/1), distorted COD rods and COM were found whereas at low Ca^{2+}($Ca^{2+}/C_2O_4^{2-}$ =1/20) concentrations, 100% twin and twisted COM were obtained. In conclusion, all the acids are effective in inhibiting Calcium Oxalate precipitation in synthetic urine solutions at various Ca^{2+} ion concentrations. However, PHBA has the strongest inhibition effect as it converts more stable COM into COD which is least bound to the epithelial cells in kidneys.

Keywords: Calcium Oxalate Dihydrate, p-Hydroxybenzoic Acid, Inhibition, Kidney Stone

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Synthesis and characterization of iron(III) triethanolamine trigallate complex as a mimic to enterobactin

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Siderophores are low molecular weight chelators secreted by microorganisms to scavenge iron from their environment, with catecholate siderophores such as enterobactin effectively binding ferric ions (Fe^{3+}). In this study, a method was developed to synthesize a ligand, triethanolamine trigallate (TETG), to mimic the structure and function of enterobactin. The synthesis involved esterification of gallic acid with triethanolamine via the acyl chloride method, which is cost-effective compared to the synthesis of enterobactin, yielding a viscous reddish-brown product. Characterization of TETG was performed using FT-IR and UV-Vis spectroscopy, with results supporting successful synthesis. The FT-IR spectrum showed a broad O-H stretching band at 3090-3670 cm^{-1} and a C=O stretching band at 1558 cm^{-1}, along with C−O and C−N stretching bands at 1179 cm^{-1} and 1048 cm^{-1}, respectively. A comparative analysis showed that FT-IR features of TETG mimic enterobactin, confirming its biomimetic properties. The UV-Vis spectrum displayed characteristic $\pi \rightarrow \pi^*$ transitions at 235 nm and 265 nm, and an $n \rightarrow \pi^*$ transition at 320 nm. Upon complexation with Fe^{3+} ions, hypsochromic shifts of intramolecular electron transition bands and broad peaks at 500-600 nm, corresponding to d-d transitions, confirmed metal-ligand interaction. The pH-dependent binding of ferric ions, studied between pH 1.82 and 6.45, revealed three coordination modes, with λ_{max} values around 580 nm, 550 nm, and 520 nm, reflecting changes in complexation behaviour. With its iron chelating ability, potential applications of TETG extend to environmental remediation, such as removing iron contaminants, demonstrating its versatility. In conclusion, this study highlights the successful synthesis of TETG and its potential as a biomimetic siderophore for iron chelation.

Keywords: Enterobactin, FT-IR, Siderophores, UV-Vis

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Effect of gum arabic edible coating incorporated with cinnamon leaf oil for extending the shelf life of "Ambun banana" (*Musa acuminata*, AAA)

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Banana is a tropical fruit, that contains valuable nutrients and are among the most traded fruits in the world. However, they are highly perishable and lead to a shortened shelf life. Furthermore, postharvest loss of banana is approximately 30-40% due to lack of proper storage methods. Generally, low temperature storage, controlled atmosphere and hypobaric storage techniques are used to prolong shelf life, but these methods can be very expensive to implement on a commercial scale. Therefore, this study aims to investigate the effect of gum arabic (GA) edible coating incorporated with cinnamon leaf oil (CLO) for extending the shelf life of banana. Treatments were included GA (10%) combination with cinnamon leaf oil in four different concentrations (1%, 0.5%, 0.25%, and 0.05%), only GA, and uncoated sample as the control. The treated fruits were stored at 25 ℃, 60% RH for 15 days and data were taken at 3 days intervals. The physiochemical characteristic including weight loss, titratable acidity (TA), pH, brix, color and brix/acidity ratio analysis were done in triplicate according to the AOAC standard methods. The composition with 10% GA and 0.25% CLO, showed the best results than other treatment at the end of the storage ($P<0.05$). Resultant weight loss (15.10±1.12%), L* (54.80±0.07), a* (-2.1±3.10), b* (20.8±1.36), brix (6.6±0.40°), TA (0.15±0.01%), brix/acidity ratio (45.50±5.70) and pH (5.32±0.14) prove to be efficient to prolong the shelf life. These findings suggest that 10% GA plus 0.25% CLO as a coating can be used for extending the storage life of banana fruits for up to 15 days.

Keywords: banana, cinnamon oil, edible coating, gum arabic, post harvest losses

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Smart packaging for food spoilage assessment based on *Brassica oleracea* anthocyanin loaded purple yam starch films

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Smart packaging is an emerging technology in the food industry that uses intelligent and active materials to monitor spoilage in real-time and to extend the shelf life of products.In this study, films were produced from purple yam starch and pectin using the solvent casting method, with anthocyanin from red cabbage added to assess their potential for indicating food freshness as its color vary with pH. The molecular structure of the films was characterized using FTIR, and their physical properties, including thickness, moisture content, and solubility, were evaluated. pH-sensitive films were applied to monitor the spoilage of fish, yogurt, and mushrooms during storage at room temperature (28 ± 2 ℃) for two days. The purple yam starch-based films exhibited better properties, including thickness (0.16±0.00 mm), moisture content (19.61±1.25%), and solubility (38.85±0.83%), compared to the pectin-based films. Both films showed the fastest color migration in acidic conditions when immersed in aqueous, acidic, low-fat, and fatty food simulants. The films also displayed visual color changes corresponding to pH variations when the foods spoiled. When fresh, the purple yam starch-based film was dark purple, and the pectin-based film was dark red. As the yogurt spoiled, the purple yam starch film turned light purple, and the pectin film turned light red. Both films turned green when the mushrooms and fish spoiled. These findings suggest that *Brassica oleracea* anthocyanin-loaded purple yam starch films have strong potential as visual indicators of food storage and consumption conditions.

Keywords: food freshness indicator, pH sensitive indicators, purple yam starch, red cabbage anthocyanin, smart packaging

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Method development to investigate the food colorants using derivative spectrometry

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The increasing use of synthetic colorants in food products to enhance their visual appeal necessitates the development of efficient, accurate, and affordable analytical methods. This study introduces an optimized UV-Vis derivative spectroscopic method designed for the qualitative and quantitative determination of food colorants, with sunset yellow, tartrazine yellow, carmoisine red, acid orange, and congo red used as model compounds. Unlike conventional UV-Vis methods, this approach simplifies sample preparation and reduces analysis costs while maintaining high accuracy and sensitivity. A novel aspect of this method is its application to binary mixtures of tartrazine yellow (E-102) and sunset yellow (E-110). Qualitative analysis was achieved by identifying isosbestic points, while quantitative analysis utilized calibration plots with excellent linearity (R = 0.9971 for E-110 and R = 0.9936 for E-102) up to 12.50 μg/mL. Zero-crossing wavelengths (528.0 nm for E-102 and 482.0 nm for E-110) enabled precise quantification. These results were utilized to determine the presence and concentration of food colorants by analyzing the calibration plots and zero-crossing wavelengths, ensuring accurate identification and quantification of E-110 and E-102. The results showed the ability to detect and quantify these colorants in both synthetic mixtures and commercial food products. Validation confirmed the method's reliability and consistency, highlighting its potential for qualitative and quantitative applications. This study also highlights the method's wider use for different synthetic colorants and commercial products, showing its potential as a dependable alternative to more complex analytical methods.

Keywords: food colorants, isosbestic points, UV-vis derivative spectroscopy

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Investigation of chelation behavior of curcumin with heavy metal ions, Cd (II) and Pb (II)

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Curcuma longa, known as turmeric, has a significant role in traditional medicine because of its antioxidant, anti-inflammatory, anti-mutagenic, anti-microbial, and anti-cancer properties. The yellow color of turmeric is due to the curcuminoids which consist of curcumin, demothexycurcumin, and bisdemethoxycurcumin. Curcumin is bis (4- hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione and a bis-α, β-unsaturated β-diketone. They show keto-enol tautomerism depending on the pH of the medium. The variation of curcumin absorbance was studied under different pH. At pH 1-9, curcumin had a peak absorbance at the wavelength of 425 nm. For the sample with pH 10, a bathochromic shift occurred from 425 nm to 440 nm. This alteration exhibited the color change from yellow to orange. It is well known that curcumin's keto-enol group binds to metal ions by chelation. Heavy metal chelation of curcumin provides a promising solution for heavy metal poisoning. The heavy metal ions Pb (II) and Cd (II) were reacted with curcumin at pH 10 to synthesize reddish-brown color complexes. The melting points of these metal-curcumin complexes were +220 ^{0}C. After complex formation, a slight pH drop in the mixture was observed from pH 10.45 to 9.40 due to the release of protons to the media by the enol form of curcumin. The Fourier-transform infrared spectra were studied for pure curcumin and curcumin-metal complexes. Changed spectra with reduced OH peaks at around 3250 cm $^{-1}$ were observed for curcumin-metal complexes.

Keywords: FTIR spectroscopy, Heavy Metal, Metal chelation, Turmeric, Curcumin

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Investigation of catalytic activity of tire pyrolysis char (TPC) as a heterogeneous fenton catalyst for the degradation of Reactive Black 5

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Fenton reaction is considered as one of the effective methods for the degradation of colored wastewaters. Hydroxyl radicals generated in-situ by the reaction of Fe^{2+} with H_2O_2 are responsible for color degradation. Heterogeneous Fenton catalyst has attracted considerable interest as it generates less iron sludge and the possibility to re-use the catalyst with a higher efficiency. TPC is a by-product of the waste-tire pyrolysis process which has no economical value, hence the disposal is problematic. The proximate analysis of TPC revealed that the presence of many metallic impurities including 0.43% (w/w) of iron which is the catalyst for Fenton reaction. Therefore, the potential of using TPC as a heterogeneous catalyst for the Fenton reaction was investigated by the degradation of Reactive Black 5 (RB5) dye. The initial characterization of TPC was done by CHN, SEM, FTIR, and XRD analyses. The preliminary investigation into the decolorization of RB5 solution showed that TPC with H_2O_2 resulted in significantly greater decolorization compared to TPC or H_2O_2 alone. Accordingly, TPC as the catalyst for the Fenton reaction achieved 99.45% decolorization efficiency for 100.00 mL of 100 ppm RB5 solution under the optimized conditions of 0.10 g of TPC 3.6 mM of H_2O_2 concentration, pH of 3 and 30 minutes of reaction time at the stirring speed of 600 rpm at 30℃. 200 µm TPC particle size showed higher decolorization efficiencies as 99.45% when compared with 500 µm which gives 97.07%. However, catalyst performance decreased consequently from 99.45% to 80.54%, 67.5% and 59.94% over four cycles. It was revealed that catalyst functionality can be restored to 94.33%-95.80% by iron impregnation in 500 ppm $FeSO_4.7H_2O$ solution for 120 minutes after each cycle of usage. Therefore, TPC can be used as an effective Fenton catalyst for the degradation of RB5.

Keywords: Heterogeneous Fenton Oxidation, RB5, Reusability, Tire Pyrolysis Char (TPC)

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Investigation of indian ocean dipole-induced rainfall variability over Sri Lanka

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The Indian Ocean Dipole (IOD), a dominant climate mode in the Indian Ocean (IO), is characterized by oscillating sea surface temperature (SST) anomalies between western and southeastern IO. Its positive (pIOD) and negative (nIOD) phases significantly influence tropical IO climate dynamics, including Sri Lankan rainfall. However, the asymmetry in Sri Lankan rainfall response to IOD teleconnections remains largely unexplored, highlighting a critical research gap. This study addresses this gap through composite analysis of observational data, in-situ rainfall data, and historical simulations from a Coupled Model Intercomparison Project Phase 6 (CMIP6) model (IPSL-CM6A-LR). We used multiple linear regression and anomaly reconstruction to isolate IOD-induced effects on IO dynamics. Results show that during the peak IOD period (September to November), a significant increase in rainfall over the Western IO (WIO) and Sri Lanka during pIOD phases, with this increase being greater than the decrease in rainfall during nIOD phases, leading to an asymmetry in rainfall variability. The asymmetry in SST anomalies, which enhance convection and moisture convergence over WIO and extend to Sri Lanka drive this strong intensity in pIOD events. These results emphasize the asymmetric nature of IOD-induced rainfall variability in Sri Lanka and highlight their critical implications for improving seasonal weather forecasting, water resource management, agriculture, and disaster preparedness in the region.

Keywords: Air-sea interactions, Indian Ocean Dipole, Rainfall, Sri Lanka.

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An algorithm for rainbow coloring of the extended version of flower graph

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Graph theory, a pivotal area in discrete mathematics, encompasses various concepts, including graph coloring, which involves assigning colors to vertices or edges. Graph coloring involves assigning colors to vertices or edges. Edge coloring refers to the process of assigning colors to the edges of a graph such that no two adjacent edges are assigned the same color, while optimizing the number of colors required for the assignment. A rainbow path in an edge-colored graph is defined as a path in which no two edges share the same color. A graph is said to be rainbow-connected if every pair of vertices is connected by at least one such rainbow path. The minimum number of colors required to ensure that a graph is rainbow-connected is referred to as the rainbow connection number ($rc(G)$). In this study, we have introduced the extended version of flower graph $EFL_m(n)$ having n number of petals and can be obtained using the subdivisions of having $2+m$; $m \in \{1,2,3,\dots\}$ vertices for each petal and with vertex set $V\left(EFl_m(n)\right) = \{r, t_i, s_{ij}\,; 1 \le i \le n\,, 1 \le j \le m\}$ and edge set $\left(EFl_m(n)\right) = \{rt_i, rs_{ij}, t_i s_{ij}\,;\ 1 \le i \le n\,, 1 \le j \le m\}$. We present an algorithm for effectively implementing rainbow coloring on this extended flower graph and our findings contribute to understanding the complexities of rainbow connectivity in graph structures. Future work will focus on establishing the rainbow connection number for this extended flower graph, further enriching the field of graph theory and its applications.

Keywords: Edge coloring, Flower graph, Rainbow coloring, Rainbow connection number

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A natural uniform structure on inductive groupoids

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An inductive groupoid is an internal groupoid in the finitely complete category of posets and monotone maps, with the additional property of admitting restrictions and corestrictions of morphisms. This algebraic structure is particularly useful for describing partial symmetries of an object and is closely related to the notion of inverse semigroups. A seemingly unrelated concept from analysis, namely uniform spaces, allows us to generalize notions such as uniform continuity, and Cauchy completeness without requiring a metric. In general, there is no canonical way to introduce a uniform structure on to an arbitrary groupoid. In this study, we investigated how a specific type of uniform structure applies to inductive groupoids in a functorial manner. We started with Alexandrov topology on the set of morphisms of the inductive groupoid and were able to prove the existence of a uniform structure on the groupoid. We observed that under this Alexandrov uniformity, all groupoid structure maps except the multiplication map are uniformly continuous. This observation led to further refinement in our analysis, by introducing two, left and right, uniform structures. For both, all structure maps, except the multiplication, are uniformly continuous respectively. Moreover, when left and right uniformities coincide the multiplication also becomes uniformly continuous. Therefore, every map on inductive groupoids is uniformly continuous under Roelcke uniformity, which is the intersection of left and right uniformities.

Keywords: Inductive Groupoids, Roelcke Uniformity, Uniform Groupoid, Uniform Spaces

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Integer and fractional order reaction diffusion systems for spatial and temporal pattern dynamics of cancer cells

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This research explores the use of reaction-diffusion systems, including their fractional counterparts, to model the spatial dynamics of cancer cell proliferation within tissue environments. The study focuses on the interaction between cancer cells and immune cells, demonstrating how these dynamics, coupled with diffusion processes, lead to the emergence of spatial patterns. The classical reaction-diffusion model, alongside the fractional models where diffusion is non-local, are analyzed to simulate cancer cell spread. The mathematical models are solved using a semi-implicit finite difference method for the classical reaction-diffusion model due to its stability and simplicity in handling local diffusion processes, and the Fourier spectral method for the fractional model as it efficiently captures the fractional order diffusion behavior. A stability analysis is done through conditions for Turing instabilities, which are crucial for understanding pattern formation mechanisms in reaction-diffusion systems. Key findings show that when $\alpha=2$, the results are smoother and more uniform structures, whereas decreasing α leads to increasingly irregular patterns that closely resemble the chaotic and invasive growth patterns observed in realistic cancer dynamics. These results underscore the importance of diffusion and reaction kinetics in understanding cancer cell behavior and highlight the potential of these models to inform future cancer treatment strategies. Future research will focus on extending these models up to 3D simulations and incorporating additional biological complexities to generate more realistic patterns.

Keywords: Fractional reaction-diffusion model, Fourier spectral method, Reaction-diffusion model, Turing instability conditions

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Developing a mathematical modelling approach to investigate coastal lagoon salinity: A case study of Nayaru lagoon

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Coastal lagoons are essential ecosystems that support biodiversity and contribute to local economies through aquaculture, fisheries and tourism. This study develops an existing one-dimensional mathematical model, incorporating hydrodynamic effects through continuity, momentum, and salinity equations to simulate water levels and both temporal and spatial salinity variations. Nayaru Lagoon located in north-east Sri Lanka has been chosen as the case study for the current research. This study acknowledges that the mathematical model employed closely aligns with the equations presented by Nunes et al. (2021). However, significant adaptations were made to the model to incorporate characteristics of Nayaru Lagoon, such as localized salinity dynamics and water level fluctuations. Although real datasets were limited, numerical simulations provided insights relevant to the lagoon's hydrodynamic behavior. These characteristics were incorporated into the model equations, which were solved using the Runge-Kutta 4th order method to ensure numerical stability and precision as a coupled system in a one-dimensional spatial framework. The sea level fluctuation data near the lagoon mouth served as input for the numerical simulation, implemented in MATLAB. The results demonstrated the model's capability to predict salinity variations accurately, aligning closely with observed data and providing a robust tool for understanding lagoon salinity dynamics. Findings offer valuable insights into local salinity dynamics which the levels range from 10 PSU (one gram of salt per 1000 grams of water) to 35 PSU and water level fluctuations, showing a good agreement with real measurements of Nayaru Lagoon. Future work aims to extend this study to higher dimensions, enhancing model sophistication. This approach demonstrates the capacity of the model to predict future salinity trends, contributing to improved coastal lagoon management.

Keywords: Coastal lagoons, Hydrodynamics, Lagoon salinity, Mathematical modeling, Water level fluctuations

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Ordinary kriging model approach for analyzing Covid-19 positive spread in Sri Lanka

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One of the most widespread outbreaks was the Covid-19 pandemic, which debilitated the entire global system. All people in the world were very keen on the daily updated situation since the spreading ability of Covid-19 was very high. This study focused on analysing Covid-19 positive spread in Sri Lanka using the ordinary kriging method. The reported total positive Covid-19 cases for (2019-2022) were collected from websites that corresponded to Medical Office Health division's/ District Secretariat Office areas. There were 271 data points covering Sri Lanka. Geographical coordinates were obtained according to the name of area. A similar Covid-19 spread density was identified by grouping collected data into five clusters based on K-means clustering and the elbow method. Then study was conducted for clusters individually. The experimental semi-variogram model was created using the variogram cloud, and ideal theoretical model was selected considering the minimum values of the Sum of Square Error and Mean Square Error. According to error comparison, the Gaussian model was suited for four clusters and the spherical model was suited for the remaining cluster. Model parameters and covariance matrix in each cluster were unequal. Results of this study reveal that the starting the spread pattern of Covid-19 in each cluster was mostly similar with different levels, and the rate of spread was different due to factors such as population density, education level, etc.. The corresponding covariance matrix can be used to predict the number of positive Covid-19 cases at locations that have not been measured. This type of risk analysis and prediction will facilitate to decision-making in pandemic situation.

Keywords: Covariance matrix, Covid-19, K-Means Clustering, Ordinary Kriging Model

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Identifying exam center locations using an integer linear programming: A case study of finding optimal locations of the examination centers for the fifth grade scholarship in the Matara educational zone

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The study intends to propose an integer linear programming model for accurately identifying exam centers. As a case study, the grade five scholarship examination in the Matara educational zone is selected. Accurate identification of examination centers is crucial for both students and the government. We proposed an integer linear programming model for accurately identifying exam centers, and as a case study grade five scholarship examination in the Matara educational zone is selected. The model is designed to be efficient using binary decision variables to capture the choice of centers and to identify the schools to these centers. The objective is stated as minimizing the number of exam centers and the total distance from schools to the assigned locations as long as all the schools are allocated to the requisite number of centers considering the capacity and distance limitations. Other important constraints are that no more than one center is allocated to each school, no center exceeds its assumed capacity, and no school is more than a km from its designated center. Here the distance a km is decided by the decision makers considering the regional requirements and factors. The proposed integer linear programming model is solved using the branch and bound algorithm implemented in the MATLAB software package. The obtained results reached incorporated recommendations to the effect that up to thirteen examination centers be established for use by ninety four schools with matching requirements of capacities and distance limits. The proposed model can be applied to find exam centers more accurate and optimal way.

Keywords: Capacity, Distance, Exam center optimization, Integer Linear Programming, Matara District

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Analyzing dengue cases in Sri Lanka with Zero-Inflated poisson regression

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Dengue fever has emerged as a significant public health concern in Sri Lanka, with rising incidence rates demanding effective intervention strategies. This study proposes a zero-inflated Poisson (ZIP) regression model to analyze dengue case data, addressing challenges such as excess zeros and unobserved heterogeneity. The dataset used in this study includes monthly reported dengue cases from multiple cities across Sri Lanka, covering the period from January 2010 to December 2020. Using a Bayesian framework, we included random effects for city and time, enhancing the model's ability to account for variability not explained by fixed effects. The model demonstrated a robust fit, with a high Bayesian R^2 value of 0.85, indicating that approximately 85% of the variance in dengue cases was captured. The inclusion of random intercepts allowed for a better understanding of transmission dynamics, emphasizing the importance of tailored public health interventions that respond to localized epidemiological contexts. This means that each city can have its baseline level of dengue cases that may differ from others, as well as different temporal trends. Additionally, the minimal zero-inflation component reflects a low proportion of excess zeros, reinforcing the model's appropriateness for this dataset. This research highlights the use of the ZIP regression model as an effective tool for epidemiological studies, facilitating improved understanding and management of dengue outbreaks. The findings of the study can inform public health policies and strategies in Sri Lanka and similar settings, ultimately contributing to more effective dengue prevention and control measures.

Keywords: Bayesian framework, Dengue fever, epidemiology, public health, zero-inflated Poisson regression

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Assignment of vehicles based on the arrival time and the processing time at the indoors of a logistics center: A hybridized approach

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The optimal assignment of vehicles to the doors of a logistics center will enhance the efficiency of a supply chain in transportation problems. The current study is an extended work of an existing integrated Vehicle Routing and Scheduling Problem (*VRSP*) to large-scale instances. Moreover, the existing study recommends a suitable meta-heuristic approach to solve large-scale instances of the *VRSP*. Therefore, this study aims to minimize the waiting time using an optimal assignment of vehicles by considering two different aspects; (1) the 'arrival time' of vehicles to a logistics center and (2) the 'processing time' at indoors. The objective of the study is to compare the total transportation costs incurred by applying two hybridized approaches, one for each aspect and recommend the most promising one among the two proposed approaches to solve the *VRSP*. In the hybridized approach, a Genetic Algorithm (*GA*) is proposed to optimize the routing vehicles and a Heuristic Algorithm (HA) is considered for an optimal assignment of vehicles to the indoors. That is, a *GA* is hybridized with a HA to solve the *VRSP* and referred it to as *HGA*. Moreover, *HGA* for the aspect with 'arrival time' and 'processing time' are respectively referred them to as HGA_*AT* and *HGA_PT*. The results of numerical experiments of the fifteen benchmark instances reveal that, *HGA_AT* produces not only more prominent waiting time but also the total transportation cost. Therefore, it can be concluded that, up to 10% increase in profit can be earned from *HGA_AT* compared to that of from *HGA_PT* and on average which is approximately 7%. This comparison can be extended to a multi-depot *VRSP* in future study.

Keywords: Arrival time, Assignment problem, Hybridized approach, Logistics center, Processing time

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A preliminary study of university admission cutoff Z-scores for engineering and biosystems technology

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In Sri Lanka, assurance of fair educational opportunities remains a priority, especially for university admissions from both educationally advantaged and disadvantaged districts. The current study investigates whether university admission cutoff Z-scores address the disparities between these two district categories. This study examines the effectiveness of the cutoff Z-scores in ensuring fairness to educationally disadvantaged districts in Sri Lankan university admissions, initially concentrating on students admitted to the newly introduced Engineering Technology (ET) and Biosystems Technology (BST) programs. It analyzes whether district categorization influences the admission cutoff Z-score over the latest seven academic years (2017-2023), and tests the hypothesis that there was no significant difference between the two groups. Weighted average and statistical tests for cutoff Z-score data from disadvantaged and advantaged districts have been performed to analyze the descriptive analysis for the effectiveness and efficiency of the University Grants Commission (UGC) regulated university admission process. No significant difference was established in the cutoff Z-scores between these two district categories or over the academic years; thus, the hypothesis was confirmed that the present system has achieved fairness in a broader context. These findings suggest that while the process appears equitable, broader systemic disparities in resource allocation and educational quality across districts remain unaddressed. Based on this, it is recommended to gradually increase the percentage of merit-based selection in university admissions for these two programs.

Keywords: Advantaged & disadvantaged districts, Cutoff Z-score analysis, Educational disparities, Higher education, University admissions

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Cardiovascular adaptation following tapering training on Sri Lanka elite male judo players

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Cardiovascular performance in combat sports like judo can be greatly improved by tapering training before to the competition. However, the specific cardiovascular benefits of tapering remain underexplored, especially in Sri Lankan judo athletes. The present study aims to evaluate the impact of a tapering training program on cardiovascular efficiency in Sri Lankan male judo players. Twenty young judokas (N = 20) participated (17±5.8 years, 170.9±5.9 cm height, and 59.25±7.9 kg) and were randomly assigned to two groups (TG: 10 and CG: 10). Both groups underwent three training sessions per week over a two-week tapering period. Cardiovascular performance indicators, including heart rate (HR) after, HR one minute after, Total Throws (TT), index, and Total Classification (TC) were measured using the Special Judo Fitness Test (SJFT) before and after the intervention. Standard descriptive statistics characterized the study population, while mixed analysis of variance with repeated measures and Bonferroni post hoc tests assessed interaction and significant differences. The main results show that there was a significant interaction was identified on HR After ($P < 0.05$), TT ($P < 0.05$), Index ($P < 0.05$) and TC ($P < 0.05$), while within group analysis shown a significant increment in HR after ($p < 0.05$), TT ($p < 0.05$), index ($p < 0.05$), and TC ($p < 0.05$) following TG. After comparison in both groups, significant differences were shown in TT ($P < 0.05$) and index ($P < 0.05$) following TG. It suggests that possible cardiovascular and muscular endurance adaptations occurred due to the increase in HR after and amount of TT, while decrease in HR 1min after signify the increases of recovery capacity, which was imply to increase the SJFT classification. Overall, it is concluded that tapering training could improve the higher performance in the pre-competition period.

Key Words: Cardiovascular efficiency, Heart rate, Judokas, SJFT, Tapering

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Influence function-based confidence intervals for robust versions of Lorenz curve

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Empirical likelihood is a non-parametric approach that enables drawing statistical inferences without assuming specific probability distributions with desirable asymptotic properties. The influence function provides a powerful tool to assess the robustness and efficiency of statistical estimators by capturing data variations. The conventional methods for estimating the Lorenz curve based on income data rely on biased and inaccurate inferences due to sensitivity to outliers, violation of traditional assumptions, and sometimes income data not following a specific distribution or distribution that is complex. Hence this study aims to better handle outliers and achieve accurate interval estimation by incorporating influence functions into the empirical likelihood framework. The influence function-based inferences for the usual Lorenz curve had been done in previous studies. This study addresses the gap in the literature by considering three quantile inequality measures that are defined by replacing mean-based terms in the definition of the general Lorenz curve with quantiles to ensure robustness. The confidence intervals are developed for robust versions by optimizing the empirical log-likelihood function using the Lagrange multiplier approach under constraints derived from influence functions and based on its chi-squared distributional convergence. Visual inspection of findings shows that confidence intervals cover true measures almost everywhere. Simulations are conducted to evaluate the performance of intervals focusing on coverage probabilities and their average lengths. The quantile-robust versions are adaptable to income data with the presence of extreme values. Their influence functions are bounded and provide accurate information for economics, social sciences, and policy analysis.

Keywords: Empirical likelihood, Influence function, Lagrange multiplier approach, Lorenz curve, Quantile inequality measures.

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A Data-Driven R shiny application for predicting graduate admission chances using beta regression analysis

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Pursuing graduate studies is a crucial milestone for many aspiring scholars; however, candidates are often unaware of the key performance metrics for admission. The uncertainty surrounding application outcomes frequently compels students to apply to multiple programs, thereby increasing their expenses. Moreover, if their applications are unsuccessful, they should wait for the next admission cycle. To address this challenge, we developed a user-friendly, web-based application using R Shiny that identifies the key factors influencing an applicant's chances of admission to higher study programs. This Study presents an innovative tool that utilizes R shiny and beta regression to predict graduate admission probabilities, an approach not previously explored in existing tools. By offering personalized, data-driven insights, the application helps applicants optimize their profiles and minimize uncertainty in the admissions process. By leveraging a dataset comprising 500 data points from the online data repository Kaggle, the application utilizes a beta regression model to predict the likelihood of admission based on various input parameters, including GRE scores, TOEFL scores, Statement of Purpose ratings, Letters of Recommendation, University Ratings, Cumulative Grade Point Average, and research experience. The Akaike Information Criterion (AIC) was used to select the best model, and the AIC value for the best model was −1440.10. Users can input their metrics to receive feedback on their predicted admission chances, along with visual representations of data distribution, feature impact on admission likelihood, and partial dependence plots, which are model-agnostic visualization tools. The application aids higher study applicants in understanding performance indicators, making informed decisions, and strengthening applications, ultimately improving their chances of admission.

Keywords: Admission predictor tool, Data-Driven modeling, Graduate admission Prediction, Graduate school admission, Predictive modeling

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A review of the adequacy of fire safety resources for high-rise buildings in Sri Lanka

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Fire safety is a crucial issue due to the difficulty of evacuating the residents and controlling the fire in high-rise buildings. In Sri Lanka, 1,297 building fires were reported between 2011 and 2020. However, no major fire has been reported yet in a high-rise building. The fire brigade and responsible parties in a high-rise building should be equipped with adequate fire and rescue facilities. Some countries have enhanced their fire safety aspects parallel with the development of high-rise building construction. Therefore, there is a requirement to investigate whether Sri Lanka has taken enough precautions for the fire safety of high-rise buildings and has enough resources to control a fire in high-rise buildings. In this study, growth of high-rise building population during the 2006-2020 period, and current fire and rescue resources availability in Sri Lanka were examined and compared with the recommended amounts given in guidelines. It was discovered that the number of high-rise buildings in the Colombo Municipal Council (CMC) has been growing exponentially between the years of 2006 and 2020. The study revealed that the number of fire stations within the CMC area are adequate with standards. However, the available resources in the Colombo fire service department are only adequate to extinguish a single high-rise building fire in one instance, not adequate for two or more simultaneous fires. Further, the required minimum amounts of fire rescue equipment were identified. Consequently, a requirement to improve the fire and rescue resources currently available in the fire service department has arisen.

Keywords: Fire safety, guideline, high-rise, population, resources

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A hybrid CNN-HOG based feature extraction approach for tamil handwritten village name recognition using SVM

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Recognizing village names in handwritten Tamil presents a significant challenge for those working in the postal sector, due to variations in handwriting. This research aims to address this issue by developing and evaluating four different approaches. The first approach utilizes Histogram of Oriented Gradients (HOG) feature extraction combined with a Support Vector Machine (SVM) for classification. The second approach implements a Convolutional Neural Network (CNN) for the direct recognition of handwritten village names. The third approach utilizes the CNN for feature extraction and SVM for model training. The fourth approach integrates HOG and CNN for feature extraction and SVM for classification. Each of the 30 village names considered for this study is represented by 250 images, resulting in a total of about 7,500 images. SVMs with HOG features achieve a recognition rate of 92.11%, while CNNs achieve a recognition rate of 91.45%. The CNN - features combined with the SVM model yields a recognition rate of 95.61%, and the hybrid CNN-HOG features with the SVM model achieves a recognition rate of 98.25%. These results indicate that the hybrid CNN-HOG based feature extraction approach with the SVM model outperforms both the SVMs and CNNs.

Keywords: CNN, HOG, SVM, Tamil Handwritten Village Name

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Transducer system for driving pedals and a traffic sign recognition system to guide prosthetic users

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In modern days, driving is a necessity since it provides independence and mobility. Due to the fact that prosthetic limbs are unable to replace natural limbs in terms of sensation or control, driving could be particularly difficult for prosthetic users. In order to address these challenges and improve the driving experience for prosthetic users, a novel system integrating machine learning, feedback, and sensor technologies has been developed. Moreover, the proposed system is designed to be compatible with most vehicles and includes a transducer for precise pedal pressure awareness while operating a vehicle. An actuator system coupled with a LED panel indicator provides immediate feedback on the pressure applied to the pedals within 40ms, ensuring optimal control and comfort. In addition, the system features a voice assistant that offers real-time traffic sign recognition using the YOLOv8 image processing algorithm. The system is able to recognize and comprehend traffic signs in a variety of settings with the accuracy of 95%. By the added voice assistance, the user receives timely and discreet information on traffic signs, which makes driving safer and convenient. The voice assistance system is programmed in "Sinhala" language to be compatible with the locals. This device makes a broad approach to provide the benefit towards prosthetic users by combining machine learning expertise, user-centric design, and innovative engineering.

Keywords: Machine Learning, Prosthetics, Transducer

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Preliminary performance evaluation and improvement of a typical food dehydrator

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This research project explores the optimization of a food dehydrator's performance through a series of eight drying tests. Each test aimed to assess various factors affecting the dehydration process, including temperature, airflow, plate rotation, and equipment modifications. Results indicated that temperature plays a crucial role in weight reduction, with higher temperatures leading to more significant reductions of moisture within a given timeframe. Adjustments such as regulating air supply gaps, barricading to prevent direct hot air contact and introducing an air exhaust at the top of the door (In testing) demonstrated improved uniformity in weight reduction across drying plates. Moreover, drying plate rotation after a certain duration contributed to more consistent drying outcomes. The findings underscore the importance of airflow management and equipment design in achieving uniform dehydration. Recommendations include insulating the heating element side, improving plate rack design, improving air flow and air holes design for enhanced efficiency. These performance evaluations suggest possible operational enhancements and future optimization efforts. This study provides valuable guidance for improving the efficiency and effectiveness of food dehydration processes, with implications for food preservation, energy conservation, and process optimization in small-scale applications.

Keywords: Efficiency, Effectiveness of food dehydration, Performance evaluation

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Thermal and mechanical properties of new wood-based eco-friendly thermal insulation

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The environmental disadvantages of conventional insulation materials which are non-degradable and contain synthetic materials have led to the development of eco-friendly insulation materials. This research focuses on the development of a sustainable wood-based thermal insulation panel with the use of natural and readily available materials like Mahogani wood waste, paper waste and coconut coir. Urea formaldehyde resin was used as the binder and peel ply was used as the release agent in the hot-pressing method of sample preparation. The ratios and sizes of the materials were varied to improve the thermal and mechanical performance of the developed panels and these samples were prepared in square dimensions of 15 cm × 15 cm, with a uniform thickness. The samples were tested for their thermal conductivity, hardness, impact strength, and wear resistance. The results show considerable variation in thermal conductivity, with the lowest value being 0.120 W/mK, highlighting the material's potential as an effective insulator. Mechanical property analysis also provided evidence that the panels possess the required strength and endurance. This research also raises the idea of using waste materials to produce environmentally friendly insulation products while still achieving the necessary performance.

Keywords: Environmental friendly, Coconut coir, Sustainable materials, Thermal Insulation, Wood waste,

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Design of a vacuum brake system for a Suzuki Wagon R car as an alternative to the hydraulic brake system

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This research explores the feasibility of designing a vacuum brake system for the Suzuki Wagon R as an alternative to traditional hydraulic brake systems. The need for this system arises from limitations in hydraulic brakes, such as higher maintenance costs, operational complexities, and reduced efficiency in certain conditions. Additionally, the increasing demand for cost-effective and simpler braking solutions in light vehicles emphasizes the introduction of vacuum brakes as a viable alternative. The design incorporates a mechanically actuated brake drum assembly with a vacuum cylinder generating a peak pressure differential of 0.7 bar. Thermal analysis confirmed a peak temperature rise of 45°C under normal braking conditions, ensuring material integrity. The vacuum brake system achieves a deceleration rate of 7.4 m/s² reducing stopping distances by 12%. The braking force produced by the vacuum brake system is 18% higher than that of hydraulic brakes under similar conditions. Further, the system demonstrated an efficiency improvement of 10% over traditional systems. The research contributes to a practical, affordable braking solution for the Suzuki Wagon R, a popular vehicle in regions like Sri Lanka and India. This study demonstrates higher deceleration and braking efficiency. The findings support the viability of the vacuum brake system as an efficient and budget-conscious alternative for light passenger vehicles.

Keywords: Braking Efficiency, Brake Drum Assembly, Regenerative Braking, Suzuki Wagon R, Vacuum Brake System

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Design of a heat exchanger with corrugated tubes for ethanol production line

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Heat transfer efficiency is an important factor for the satisfactory performance and sustainability of ethanol production. The production process for ethanol includes many heat transfer processes, such as fermentation, distillation, and rectification. Heat exchangers are an important component to facilitate efficient heat transfer in these processes. This research aims on the design of a shell-and-tube heat exchanger that is optimized for an ethanol production line considering common modes of challenges such as fouling, corrosion, and thermal stress failure. In this design, fixed head type shell and corrugated tubes together with a counterflow configuration will be employed to achieve high efficiency. The design calculations were done using Kern's method. Stainless Steel 316 was chosen to ensure the highest corrosion resistance and durability in the environment with ethanol. The optimized design achieved heat transfer efficiency in the range of 2.0% to 2.6% with reduced energy consumption, while mitigating failure modes through material selection and robust configuration. This combination of high-efficiency design and proper material selection provides a sustainable solution for energy-efficient ethanol production.

Keywords: Corrugated Tubes,, Corrosion Ethanol, Fouling, Heat Exchanger

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Design optimization of anaerobic treatment for water hyacinth, producing biogas and bio fertilizer

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Anaerobic digestion (AD) is a biological process that converts organic waste into renewable biogas and digestate, a biofertilizer. This experiment aims to study whether water hyacinth, an invasive plant in Sri Lanka, can be effectively used for biogas production and improving the biogas yield by referring to some key factors such as particle size of feedstocks, controlling pH, C/N ratio, temperature, and using a two-stage anaerobic digestion process. An IoT based pH monitoring system was designed to ensure real-time pH monitoring to maintain optimal conditions during digestion. By comparing single stage and two stage digesters, the study focuses on improving methane production and process efficiency. In addition, pretreatment of feedstock was also introduced to enhance bacterial activity. The results highlight the potential of converting this invasive plant into a valuable resource for renewable energy production and agricultural sustainability, offering a cost effective solution that benefits both energy security and environmental conservation efforts in Sri Lanka. Furthermore, scaling up this process could significantly reduce environmental harm and underscore the dual benefits of waste management and renewable energy development in local communities.

Keywords: Anaerobic digestion, biogas production, renewable energy, two stage digester, water hyacinth

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An efficient algorithm to maintain convex layers of a dynamic set of points in the plane

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Let *S* be a set of *n* points in the plane. The convex layers of *S* are the convex hulls derived by repeating the following task: [compute the convex hull of *S* and delete its vertices from *S*]. A set of points is called dynamic if points can be inserted to or deleted from the set. This work proposes a novel algorithm to maintain convex layers of a dynamic set of points in the plane. The concept of convex layers is useful for robust estimators and range search in statistics. There is only one algorithm that exists in literature. The existing algorithm represents the edges of a convex layer as a set of line segments in arbitrary order. Therefore, pairwise comparison of line segments is necessary in convex layers in order to handle an insertion or a deletion. That algorithm takes $O\ (n^3/k^2)$ time for an insertion or a deletion of a point where *k* is the number of convex layers. It could be observed that the pairwise comparison is the major reason for inefficiency of the existing algorithm. The proposed algorithm eliminates this drawback by marking the vertices of each deleted edge. Thus, the proposed algorithm takes $O\ (n)$ time for an insertion or a deletion of a point which is optimal.

Keywords: Algorithms, Convex Hull, Convex Layers, Computational Geometry

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Optimizing delta debugging minimization with jump search algorithm

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Delta Debugging Minimization (*ddmin*) identifies the minimal input required to reproduce a bug from a larger failing input (i.e., an input that exposes the bug). As the given failing input increases in size, this algorithm generates an excessive number of intermediate test inputs in many real-world software bugs, which presents a significant challenge in software testing. To address this issue, this paper presents an optimization approach called JUMPDDMIN. First, it minimizes the given failing input using a linear approximation performed by the Jump Search Algorithm. Next, it applies *ddmin* to the minimized failing input. With the jump search-based linear approximation, *ddmin* receives a relatively smaller failing input for further minimization. Consequently, *ddmin* can reach the minimal bug-exposing input with fewer intermediate test inputs. This study conducted experiments on more than 2000 failing inputs from 132 different real-world bugs sourced from the Codeflaws and QuixBugs code repositories. The experiments demonstrate that JUMPDDMIN is capable of reducing the number of intermediate test inputs generated by *ddmin* in most failing inputs. For most failing inputs, this reduction exceeds 9%.

Keywords: Delta Debugging, Software Testing, Test Optimization

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Density and distribution of vector mosquito larvae (Diptera: Culicidae) in fishing boats in the coastal belt, Galle district, Sri Lanka

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Sri Lanka is frequently plagued by mosquito-borne diseases (MBD), and the Galle district is one of the top contributors to MBD each year. Since the insufficiency of previous studies on fishing boats as mosquito breeding sites, the current study was conducted to investigate the density (D) and distribution (C) of larval vector mosquitoes in fishing boats in the coastal belt, Galle District, Sri Lanka. In three main localities (Galle, Hikkaduwa, and Ambalangoda coastal area), six larval surveys were conducted monthly (January-June in 2024). Larval samples were collected from ten randomly selected boats (disregarding boat types) in each locality at each visit. Ten dips were taken from each selected boat using standard dippers (250 ml). Collected 4th instar larvae were identified using standard taxonomic keys. Density and distribution were determined using standard indices and categories. Four vector mosquito species, *Aedes aegypti*, *Ae. albopictus*, *Culex quinquefasciatus*, and *Cx. tritaeniorhynchus* were recorded. *Aedes aegypti* showed the significantly highest mean density (40.34% ±1.13, $p<0.05$) and mean distribution (60.56% ±8.68, $p<0.05$), followed by *Ae. Albopictus* (D = 30.11% ±1.13, $p<0.05$; C = 45.56% ±2.62, $p<0.05$), *Cx. quinquefasciatus* (D = 17.86% ±1.35, $p<0.05$; C = 19.44% ±2.1, $p<0.05$) and *Cx. tritaeniorhynchus* (D = 1.74% ±0.35, $p<0.05$; C = 4.44% ±0.64, $p<0.05$). *Aedes aegypti*, *Ae. albopictus*, and *Cx. quinquefasciatus* were recorded under the `dominant` density category, and *Cx. tritaeniorhynchus* was under the `subdominant` category. Both *Aedes* spp. showed a `moderate` distribution category and both *Culex* spp. recorded a `sporadic` distribution category. In order to control future MBD outbreaks in the coastal zone, this knowledge is vital in implementing effective vector mosquito larval management programs.

Keywords: Breeding sites, Coastal belt, Mosquito-borne diseases

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The determinants of nonadherence to oral bisphosphonates in osteoporosis management: A narrative review

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Oral bisphosphonates are the first-line treatment for managing osteoporosis. Multiple studies across various countries have demonstrated low adherence to bisphosphonates. This review aims to evaluate the determinants of nonadherence to oral bisphosphonates in patients with osteoporosis. Twenty research papers, in English, published between 2006 and 2024 were extracted from electronic databases, including Google Scholar and PubMed, using the keywords “adherence”, “determinants”, “oral bisphosphonates”, and “osteoporosis”. They were categorized as medication-related, patient-related, disease-related, and sociodemographic factors. The main medication-related factor influenced adherence to oral bisphosphonates is gastrointestinal events, such as gastrointestinal irritation and it is the main reason for discontinuation. Complex dosing schedules and generic medications reduced compliance. Patient-related factors such as skeptical beliefs, perceived lack of efficacy, and forgetfulness reduced adherence. Sociodemographic factors, including age, gender, race, comorbidities, educational status, marital status, cost, and copay influenced adherence. Disease-related factors, including history of fractures, healthcare utilization, and glucocorticoid use were associated with increased adherence to the therapy. Polypharmacy and androgen deprivation therapy were linked to poor adherence. The review revealed that medication-related, disease-related, patient-related, and sociodemographic factors contribute to nonadherence to oral bisphosphonates. Given the chronic nature of osteoporosis, medication adherence is crucial in achieving better health outcomes. Therefore, understanding these determinants is essential in developing effective strategies to enhance long-term adherence to oral bisphosphonates.

Keywords: Adherence; Determinants, Oral Bisphosphonates, Osteoporosis

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Macrobenthos diversity in the Manalkaadu dune slacks of Jaffna, Sri Lanka

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Macrobenthos are an important group of organisms for maintaining the ecosystem balance. Dune slacks are temporary wetlands in dry dune areas where water level fluctuate with the seasons creating unique ecosystems. The present study aims to document the macrobenthos diversity of the dune slacks ecosystems. The study was conducted in four selected dune slacks from the Manalkaadu sand dunes located in Jaffna during May 2024. Four sediment samples were collected from each slack using a core sampler at a depth of 20 cm. The size of the dune slacks ranged from 100 m² to 2250 m², with water depths between 0.30 m and 0.90 m. Water quality parameters, including temperature, pH, conductivity, total dissolved solids (TDS), and Salinity, were measured using field water quality meters. Collected samples were preserved in 10% formalin and stained with rose Bengal solution for laboratory analysis. Macrobenthic species were identified using their morphological and morphometric characteristics. A total of 1231 individuals, representing five species of gastropods from five families, were identified. The families included Thiaridae (33.23 %), Viviparidae (1.95%), Planorbidae (1.62 %), Ampullariidae (0.41%) and Neritidae (0.24%). Species dominance varied among sites, *Melanoides tuberculata* was dominant in site A and B, *Indoplanorbis exustus* in site C and *Bellamya dissimilis ceylanica* in site D. Salinity ranged between 0.09 ppt and 0.47 ppt at all the sites. All identified species were freshwater macrobenthos, indicating the freshwater nature of the dune slack ecosystems. This study provides the first documentation of macrobenthic diversity in the dune slacks of Jaffna, Sri Lanka and further research is necessary to assess the seasonal variations in species composition and their ecological roles in maintaining the health of dune slack ecosystems.

Keywords: Diversity, Dune Slacks, Freshwater, Jaffna, Macrobenthos

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Safe handling practices of anti-neoplastic drugs and associated factors among nurses of selected government hospitals in Sri Lanka

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Inappropriate handling and use of anti-neoplastic drugs lead to occupational health hazards among nurses in cancer management settings. Therefore, in this cross-sectional study, the safe handling practices of anti-neoplastic drugs and associated factors were evaluated among nurses of selected government hospitals in Sri Lanka. Nurses from four government hospitals were included in this study. A stratified random sampling technique was used to select 421 nurses. A pretested and self-administered validated questionnaire was used. A 24-item questionnaire was used to collect safe handling practices of anti-neoplastic drugs. The highest and lowest attainable scores for practice were 26 and 0 respectively. The median score of practice score was used as cut-off value, based on which the practices were categorized as either good or poor practice. Chi-square test was used to assess the association between practice and different factors at the 95% confidence interval and p-value less than 0.05 was considered statistically significant. The response rate of nurses was 93.34% (n=393). The median score of practices was 21 (IQR=5). Only 31.8% (n=125) of nurses had good practice in the safe handling of anti-neoplastic drugs. Factors associated with practice were age ($p<0.001$), marital status ($p<0.001$), work experience ($p<0.001$), experience in handling anti-neoplastic drugs ($p<0.001$), training received ($p=0.002$), having adequate time for safe handling practice ($p=0.002$), number of administration of anti-neoplastic drugs per day ($p<0.001$) and having adequate personal protective equipment ($p<0.001$). Safe handling practice of anti-neoplastic drugs was poor among the majority of nurses. Safe handling practices of anti-neoplastic drugs among nurses could be improved by considering the significant factors.

Keywords: Anti-neoplastic drugs, Nurses, Safe handling practices, Sri Lanka

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Impact of environmentally relevant concentrations of acetaminophen exposure on the growth and survival rate of Zebrafish (*Danio rerio*)

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Non-steroidal-anti-inflammatory drug, acetaminophen is the most abundant pharmaceutical pollutant with potential adverse effects on non-target organisms. This study investigated the impact of long-term acetaminophen exposure on the growth and survival of juvenile zebrafish. 25-day-old zebrafish were exposed to environmentally relevant acetaminophen concentrations (10 and 75µg/L) and control treatment for 60 days. Fish were fed once daily at 2% of their body weight and maintained in triplicate tanks with semi-static water renewal every 3 days. The mean length gain, weight gain, specific growth rate (SGR), condition factor (CF), and survival rate were determined. The mean weight gain, mean length gain, and SGR were highest in 10 µg/L acetaminophen-treated fish (0.049 g,0.24 cm, 0.67) followed by 75 µg/L (0.048 g,0.19 cm,0.64) and control (0.045 g,0.18 cm,0.62). However, the values were not significantly higher than the control fish (One-way ANOVA, $p>0.05$). The growth increments under 10µg/L potentially due to acetaminophen-induced endocrine disruption, while the reduction under 75 µg/L exposure is indicative of toxicity. CF was highest in the control group (1.605). Lower yet statistically insignificant values were observed in 10 µg/L (1.573) and 75 µg/L (1.601), suggesting no dose-dependent impact on CF. A significantly low survival rate was observed in 75 µg/L acetaminophen-treated fish (33.33%) compared to the control (72.2%) (One-Way-ANOVA, $p>0.05$). A lower yet statistically insignificant survival rate was observed in 10 µg/L acetaminophen-treated fish (50%, $p>0.05$) compared to control and 75µg/L. In conclusion, even though environmentally relevant acetaminophen exposure has minimal impact on fish growth, it significantly reduces survival rates, highlighting the potential threat of pharmaceutical pollution to overall ecosystem health.

Keywords: Acetaminophen, Environmentally relevant doses, Growth, Survival Rate, Zebrafish

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Synergistic effects of biochar and nitrogen fertilizer on soil properties and yield of rice grown in low country dry zone of Sri Lanka

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Enhancing rice productivity while minimizing the environmental impacts is essential for sustainable agriculture and global food security. This study investigated the synergistic effects of biochar (B) and nitrogen (N) fertilizer on soil properties and rice yield in Sri Lanka's Low Country Dry Zone during the 2023 Yala and 2023/24 Maha seasons. A split-plot experimental design was employed, testing four levels of biochar (B0: 0, B1: 1, B2: 2, and B3: 3 t ha^{-1}) and nitrogen fertilizer (N0: 0, N30: 31.5, N70: 73.5 and N100: 105 kg ha^{-1}). Statistical analyses including ANOVA were performed using Minitab 17. The application of biochar significantly improved soil properties, including water holding capacity, electrical conductivity, pH, and microbial activity in both seasons. Combined applications of biochar and nitrogen fertilizer resulted in application consistently higher rice yields compared to individual applications. The B3N100 and B3N70 treatments achieved grain yield of 12.28% and 9.47% higher, respectively, than the conventional practice (B0N100: 4.75 t ha^{-1}). Additionally, the harvest index improved from 0.50 (B0N100) to 0.57 and 0.58 for B3N100 and B3N70, respectively, highlighting significant interaction effects on rice growth and yield. These results emphasize the potential of integrating biochar and nitrogen fertilizer as a soil amendment to optimize paddy soil profiles and enhance rice productivity in sustainable agricultural systems.

Keywords: Agronomic performance, Biochar, Nitrogen fertilizer, Soil microbes, Yield

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Decaffeination of *Coffea arabica* using a sustainable solvent extraction while preserving quality

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Despite being a producer and exporter of *Coffea arabica*, Sri Lanka imports significant quantities of decaffeinated coffee to meet consumer demand for caffeine-free options. This study developed a decaffeinated coffee while preserving quality through solvent extraction. Roasted beans (180 °C) were ground, consecutively boiled and extracted using dichloromethane (DCM), which yielded more caffeine (4.6%) than ethyl acetate (4.3%). Decaffeination was confirmed via Thin Layer Chromatography (TLC) using a caffeine standard. Decaffeinated extracts were rotary evaporated, oven-dried, and ground into powder. Post-production, dry powder was evaluated for moisture, and brewed extracts were evaluated for physical stability, pH, microbial safety, and antioxidant activity. The decaffeinated coffee was slightly lighter brown colour upon brewing but retained the characteristic aroma of regular roasted coffee. Using spread plate method, product was confirmed for the absence of microbial growth. It exhibited a pH of 6.82 and 26% moisture. DPPH assay showed that decaffeinated coffee had slightly reduced antioxidant activity (IC50 ≈ 240.43 µg/mL, SD 1.32), compared to regular coffee (IC50 ≈ 219.56 µg/mL), yet retained significant antioxidant potency. This sustainable method minimizes chemical input through solvent recycling and provides a valuable caffeine by-product, ensuring efficient raw material utilization. The study offers a locally adaptable solution for decaffeinated coffee production, reducing import dependency while catering to consumers seeking high-quality, caffeine-free options.

Keywords: Antioxidant, Sustainable, Coffee, Caffeine-free, Decaffeination

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Effect of spacing and pinching on growth and flowering traits of African Marigold (*Tagetes erecta)* in dry zone

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African marigold (*Tagetes erecta)* is flourishing as an important flower crop in the dry zone. Spacing and pinching are two important cultural practices that improve the quality and quantity of marigold flowers. Therefore, a study was carried out to find the suitable spacing and pinching method for marigold cultivation. The experiment comprised two levels of spacing: 30cm x 30cm (S_1), 30cm x 45cm (S_2) and three levels of pinching: No pinching (P_0), Single Pinching (P_1), and Double Pinching (P_2). The treatments were tested in a factorial complete randomized design with three replicates from April to August 2023 at the Agriculture farm, University of Jaffna. Seedlings were planted at the specific spacings, and the pinching was done at two and four weeks after transplanting. The data were subjected to analysis of variance using SAS 9.1, and the mean separation was done using Duncan's multiple-range test method at $p < 0.05$. The results indicated that spacing and pinching methods and their interactions have a significant effect on growth and flowering traits. The maximum number of secondary branches (23.2), highest stalk length (6.16 cm), highest diameter of flower (4.23cm), highest fresh weight of flower (6.51 g), maximum number of flowers (23.5) were recorded from 30cm x 45cm with double pinching in all combinations. Maximum plant height (27.93 cm) was recorded from 30cm x 45cm spacing with no pinching. It can be concluded that 30cm x 45cm spacing with the double pinching method is most suitable for the cultivation of marigold in the dry zone.

Keywords*:* African marigold, flower trait, pinching, parameters, spacing

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Insights into SDG 6.6; Protecting and restoring water-related ecosystems through a bibliometric analysis

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The United Nations' Sustainable Development Goals (SDGs) were established to achieve several key challenges by 2030. SDG-6, "Clean Water and Sanitation" emphasizes the protection and restoration of water-related ecosystems under SDG-6.6. Exploring the research underpinning SDG- 6.6 is crucial for identifying research gaps and guiding future directions. This study aimed to find this gap through a bibliometric analysis with 'Biblioshiny' package in R. A total of 1181 articles (2015-June 2024) were retrieved from the Web of Science database using the search query: ALL = (((“aquatic” AND “ecosystem”) AND (“protect” OR “restore”)) NOT “seawater”). There was a predominant focus on freshwater ecosystems of lakes, rivers, wetlands, and aquifers, where China and United States emerged as top contributors. In line with SDG-6.6, "Management," "Biodiversity," "Water," and "Rivers" were the key research areas. The highest number of studies focused on lakes (24.38%) followed by rivers (22.26%), mountains and forests (13.29%), and wetlands (7.70%). Among them, rivers (187 articles) and lakes (176 articles) had the highest number of protection-focused studies. Chinese researchers published the highest number of publications (291), of which 73.85% were authored solely by them, while 27.15% were multi-country collaborations. Out of 1181 papers, 57% and 32 % addressed protection and restoration respectively highlighting a significant gap in freshwater ecosystems protection and emphasizing the need for a more balanced approach for their health and resilience. The study advocates prioritizing restoration research alongside protection strategies through global collaboration, interdisciplinary efforts, and increased investment to address these research gaps in freshwater ecosystems and achieve SDG-6.6.

Keywords: Bibliometric analysis, protection, freshwater ecosystems, restoration, SDGs

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Seedling survival of mangrove *Rhizophora mucronata* L. in dry zone of Sri Lanka; Impact of extreme rainfall

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Extreme weather conditions can affect the establishment, growth, and survival of mangrove seedlings often leading to failures in mangrove restoration projects. Specifically, heavy rainfall patterns play a significant role in determining the survival rates of mangrove seedlings and young saplings (age <12 months). This study investigates the effect of extreme rainfall on the survival of *Rhizophora mucronata* L. mangrove seedlings planted in Mampuriya, Kalpitiya Lagoon, in the dry zone (mean annual rainfall :1000–1250 mm) of Sri Lanka. For this study, monthly rainfall exceeding 200 mm over two-consecutive months was considered as 'extreme rainfall.' During this period, ground inundation reached 100%, with the water level rising to more than half of the seedling's stem height. A total of 900 nursery raised *R. mucronata* seedlings (2 months old) were planted and their survival was assessed monthly. End of the 6th month of planting, the survival rate had dropped to 82.4%. Survival rates of the seedlings were compared for two periods that were divided based on the obtained precipitation data [October to December (>200 mm) and January to March (<200 mm)] using the Chi-square test. The results indicated no significant association (X^2 = 0.0671, DF =1, P value = 0.79) between the level of survival of mangrove seedlings and the rainfall patterns during the study period. This suggests that *R. mucronata* seedlings exhibit greater resilience to extreme rainfall (up to even 423.1 mm) compared to other coastal plant juveniles observed in previous studies. However, we strongly recommend further research on the impacts of different levels of extreme rainfall on mangrove seedling survival.

Keywords: Chi–square, mangroves, rainfall, restoration, survival

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Effects of biofilm biofertilizer amended martian simulant soils on rice growth

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Improving the fertility of Martian regolith is essential for sustainable agriculture in extraterrestrial colonization, as its infertility is due to nutrient deficiencies. This study evaluates the potential of Biofilm Biofertilizer (BFBF) to advance the quality of Martian Soil Simulants (MSS) for improved plant growth. Serpentine soil as MSS, collected from Ussangoda (6° 05´N 80° 59´E) in the Southern Province, was sterilized and subjected to four treatments: (i) BFBF alone, (ii) Nutrient solution (NS) alone, (iii) BFBF combined with NS (10 µL:5 mL), and (iv) Control (no amendments), with three replicates in completely randomized design. Rice was used as the test plant. Seeds were germinated directly in four treatments and thinning was performed after 10 days retaining three healthiest plants for further growth. Two weeks later, plants were uprooted, and shoot and root lengths, as well as their dry weights were measured. Soil nutrients and soil microbial abundance by plate count method were assessed before and after treatments. The results showed significant improvements ($p = 0.002$) in total phosphorus (0.1499±0.0055) in MSS treated with BFBF combined with NS. Additionally, there was a notable increase in the abundance of soil fungi ($p = 0.022$) and diazotrophs ($p = 0.018$) in BFBF alone treatment. These findings suggest that the application of BFBF with sufficient nutrients can improve the quality of MSS by enhancing soil nutrients and promoting soil microbial activities, which are critical for healthier plant growth and development. However, further research is needed to fully understand the impact of BFBF on improving MSS quality.

Keywords: Biofilm Biofertilizer, Mars, Martian regolith, Mars simulant soil, Sustainable agriculture

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Carbon content in mangrove forest invaded by *Acacia auriculiformis* A.Cunn.Ex.Benth;A case study from Rekawa mangrove forest Sri Lanka

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Carbon stored and sequestered in coastal wetland ecosystems is known as “Blue Carbon”. This process is crucial in mitigating climate change by removing carbon dioxide from the atmosphere. Mangroves are vital contributors to blue carbon storage. However, mangrove ecosystems face various threats, including invasion by non-native plant species such as *Acacia auriculiformis*. This species has invaded the Rekawa lagoon region in Sri Lanka (6°03′N, 80°50′E).The study aimed to quantify and compare the carbon stock in the Rekawa Lagoon, both in areas invaded by *A. auriculiformis* and non-invaded areas. Field surveys were conducted across three site categories: non-invaded area, invaded area (totally invaded) and co-occurring area (Mangrove Species 75%, *A. auriculiformis* 25%). Data were collected focusing on above-ground, root, and soil carbon content. All the trees with GBH ≥ 8.0cm in each plot were enumerated and species were recorded. Results revealed that the above-ground carbon content in the non-invaded site, co-occurring site, and invaded site was 124 (± 6.23), 46 (± 4.75), and 34 (± 12.8) Mg C/ha, respectively. Root carbon content at a depth of 0-20 cm in non-invaded, co-occurring, and invaded sites was 8.92 (± 0.6), 7.12 (± 0.3), and 3.32 (± 0.8) Mg C/ha, respectively. Soil carbon content was 300.3 (± 8.80), 161.2 (± 13.39), and 46.4 (± 10.85) Mg C/ha, respectively. The mean total carbon content in non-invaded sites (436.83 ± 6.59 Mg C ha^{-1}) was significantly higher than in co-occurring and invaded sites. Species richness was higher in non-invaded sites. The total carbon content in invaded areas is reduced by 75%, showing its negative impact on carbon sequestration and storage. This highlights the need to manage invasive species in mangrove forests to maintain their ecosystem function and role in climate change mitigation.

Keywords; Blue Carbon, Carbon sequestration, Invasive plants, Mangrove, Total carbon content

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Vertical distribution of soil organic carbon in mangroves and adjacent build-up areas

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Blue Carbon Ecosystems such as mangroves, tidal marshes, and seagrass meadows store substantial amounts of carbon and play a crucial role in climate change mitigation. However, information on the vertical distribution of soil organic carbon (SOC) from top to bottom layers (referred to as 'vertical carbon accretion') is limited in Sri Lanka. Therefore, this study focused on assessing the vertical carbon accretion in mangroves and neighboring built-up areas in Galle, Sri Lanka. Soil samples were collected down to a depth of 1.8 m and divided into nine depth intervals; 0-15, 15-30, 30-45, 45-60, 60-75, 75-90, 90-120, 120-150, 150-180 cm. The SOC content for each depth interval was measured using the Loss On Ignition (LOI) method. Two sample t-test and One-way ANOVA statistical tests were performed. The SOC content in built-up areas, from surface to 1.8m depth, ranged as 46.74±9.76, 19.41±2.58, 10.90±1.89, 6.91±1.50, 5.49±0.94, 4.61±0.62, 7.98±1.32, 5.94±2.14, 2.67±1.10 Mg C ha^{-1} Respectively. Meanwhile, the SOC content in mangrove areas, from surface to 1.8 m depth was, 70.97±5.25, 72.44±5.78, 75.60±6.32, 70.95±7.92, 74.76±8.35, 72.19±6.45, 145.61±8.11, 137.67±8.37, 141.74±7.88 Mg C ha^{-1} respectively. There were significant differences in SOC content between the various depth intervals in built-up and mangrove areas ($p<0.05$). Further, SOC contents in built-up areas decreased with depth, and the mangrove soils stored approximately eight times more carbon than adjacent built-up areas. If existing mangrove areas are converted into built-up spaces, large amounts of carbon would be released into the atmosphere. Therefore, this study emphasizes the need to conserve current mangrove ecosystems as part of climate change mitigation.

Keywords: Accretion, Blue carbon, Conservation, Climate change, Mitigation,

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Effects of rice husk-derived biochar (RHB) on the development of iron toxicity tolerance root traits in rice

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Iron (Fe^{2+}) toxicity is one of the prevalent micronutrient disorders associated with lowland rice, primarily affecting the root system. Although, the rice husk-derived biochar (RHB) is applied as an organic amendment to enhance growth and mitigate biotic and abiotic stress, its effects on Fe^{2+} toxicity tolerance have not been systematically studied. Therefore, this study aimed to analyze the effects of RHB on the development of root morphological and root anatomical traits in the selected rice varieties grown under Fe^{2+} stress conditions for understanding root system-mediated tolerance against Fe^{2+} toxicity. A complete randomized design (CRD) was employed with a control and five RHB treatments (2.0, 2.5, 3.0, 3.5 and 4.0 t ha^{-1}) each consisting of four replicates. The experiment was conducted in double pots. All treatments were supplemented with 400 ppm of Fe which is known to be toxic for rice. At the end of 40 days of experimental time, root number and root length were determined as morphological traits and the number of fully developed air channels in the root cortex was recorded as a root anatomical trait. One-way ANOVA followed by Tukey's post hoc test was employed for data analysis. The RHB treatment levels 2.0, 2.5, 3.0 t ha^{-1} exhibited significant development in the root traits indicating enhanced tolerance against iron toxicity compared to the control; conversely, RHB levels 3.5 and 4.0 t ha^{-1} showed a reduction in the development of the root traits. The highest root length (18.837cm), root number (39) and the number of fully developed air channels (31) were recorded from the RHB treatment 2.5 t ha^{-1} . Overall results inferred RHB level depended development of iron toxicity tolerance root traits such as root number, root length and extent of an aerenchyma tissue.

Keywords: Aerenchyma, Iron toxicity, root traits, rice husk biochar

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Effect of diurnal variation on the essential oil content and composition of Lemongrass (*Cymbopogon citratus* (DC) stapf

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Essential oil from lemongrass (*Cymbopogon citratus* (DC.) Stapf) is largely used for perfumery, medicinal and culinary purposes due to its aromatic and therapeutic properties including antioxidant, antimicrobial and anti-inflammatory effects. This study aimed to investigate the effect of diurnal variation on the essential oil content and composition of *C. citratus.* The leaf samples were collected at five different times during the day (6 a.m., 9 a.m., 12 p.m., 3 p.m. and 6 p.m.). The hydro-distillation method was used to distil essential oils, and the collected essential oils were analyzed using Gas Chromatography-Mass Spectrometry (GC-MS). Results indicated that essential oil content was significantly varied throughout the tested times and the elevated essential oil contents (v/v) were reported at 6 a.m. (1.20%), 9 a.m. (1.12%) and 6 p.m. (1.11%). The essential oil was a mixture of thirty constituents and each constituent was recorded at 6 a.m. Some constituents were presented throughout the day and their contents fluctuated as citral (32.80 ± 6.25), myrcene (8.30 ± 1.64), geraniol (3.79 ± 0.93), geranyl acetate (0.59 ± 0.71), linalool (0.67 ± 0.08), sulcatone (1.02 ± 0.21), selina-6-en-4-ol (1.65 ± 0.89), isoneral (1.13 ± 0.49), isogeranial (1.56 ± 0.71) and ocimene (1.02 ± 0.21). In conclusion, the essential oil content and composition of *C. citratus* varied with diurnal variation. At 6 a.m., the maximum essential oil content with a rich composition of *C. citratus* could be obtained.

Keywords: Aromatic Plants; Diurnal Variation; Essential Oil; Gas Chromatography-Mass Spectrometry; Lemongrass

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Isolation and characterization of two underutilized tuber starches; *Dioscorea alata* and *Dioscorea esculenta* in Sri Lanka

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The increasing demand for sustainable starch sources has emphasized the need to explore underutilized tuber cultivars, especially in regions with limited access to traditional starch crops. Therefore, this study aims to address this gap by studying the properties of starches extracted from two commonly available underutilized tubers, namely Rajala (*Dioscorea alata*) and Kukulala (*Dioscorea esculenta*) to provide a foundation for broader utilization in the food industry. The wet extraction method with a browning control agent was used to isolate starch, and its physiochemical and functional properties were studied. The starch yields were approximately 12%, with low moisture, ash, fat and fiber contents indicating their high quality and purity. Both starches exhibited excellent color properties with high whiteness index, making them suitable for food applications. Moreover, both starches exhibited B-type X-ray diffraction patterns with significantly different amylose contents ($p<0.05$), 37.15 ± 0.25% for *D. alata* and 21.32 ± 0.20%, for *D. esculenta*. The starch granules of *D. alata* were oval-shaped with an average particle size of 26.35 μm, while the granules of *D. esculenta* were polygonal with an average particle size of 6.36 μm. With rising temperatures, both starches showed enhanced swelling power and solubility, with *D. esculenta* exhibiting significantly higher swelling power and solubility. The TGA study demonstrated high thermal stability for both starches with moisture loss occurring between 30 and 100°C and breakdown occurring between 250 and 450°C. Overall, the distinct properties of *D. alata* and *D. esculenta* starches demonstrate their potential as alternative starch sources for various applications, including gluten-free products, thickeners, and biodegradable packaging, providing new opportunities for the utilization of underutilized tuber crops.

Keywords: Dioscorea alata, Dioscorea esculenta, Properties, Starch, Thermogravimetric

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Reproductive performance of Jersey and Jersey x Holstein Friesian crosses in the dry zone of Sri Lanka under sophisticated intensive cattle management system

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The study was undertaken to evaluate the reproductive performance of imported Jersey and Jersey x Holstein Friesian cattle over a period of 9 years (2015–2023) at the National Livestock Development Board (NLDB) farm Ridiyagama, located in the dry zone of Sri Lanka. The records on reproductive traits viz. age at first calving (AFC), gestation length (GL), calving to service period (CSP), number of services per conception (SPC) and dry period (DP) of 4806 records of 1356 cows were used. Data were analyzed using general linear model with SAS online version. In addition to the above listed variables, year of calving, season of calving, year of dry off and season of dry off were included in the model. The overall least square means (±SEM) of studied reproductive traits were AFC: 28.83±0.003 months, GL: 275.56±0.003 days, CSP: 70.15±0.01 days, SPC: 4.28±0.002 and DP:144.84±0.04 days, respectively. The least square means (±SEM) of reproductive traits for Jersey and Jersey x Holstein Friesian crosses were AFC: 29.04±0.15 months and 28.7±0.13 month; GL: 276.77±1.33 days and 275.91±1.31; CSP: 67.47±1.11 days and 70.81±0.93 days; SPC: 4.06±0.29 and 4.42±0.28; DP: 139.94±4.11 days and 144.49±3.39 days, respectively. Current study revealed that AFC for both breeds lie within the optimum range of 24 to 30 months for cattle. The traits CSP, SPC, and DP exceeded standard values of 45-50 days for CSP, ≤ 2 for SPC and 60 days for DP. However, for these traits, Jersey showed lower values than Jersey x Holstein Friesian crosses indicating the adaptive nature of Jersey to the tropical climatic condition.

Keywords: Dry zone, Holstein Friesian, Jersey, reproductive traits, intensive management

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Development of protein rich functional soup cubes from pumpkin seeds and evaluation of its quality parameters

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Due to unhealthy food consumption and reduced nutritious food options, Non-communicable diseases (NCDs) are prevalent in the world. Increasing functional food usage can reduce risk of NCDs and promote overall body health. The objective of this study was to develop protein-rich functional food from pumpkin seeds (cucurbita pepo). Seeds with shells were dried 12 hours at 65 ºC in the dehydrator machine. Dehydrated seeds were ground and sieved. Soup cubes were prepared incorporating pumpkin seed flour in-to pumpkin flesh flour in the ratio of 1:1 and 1:3 (w/w). The same amount of corn starch, onion, garlic, ginger, salt, and pepper were added to the each ratio. Qualitative and quantitative phytochemical screening was carried out for the pumpkin seed flour. Analysis of proximate composition and nutritional properties were carried out using the standard methods. Sensory evaluation was done to select the best formula. It was found that seeds contain alkaloids flavonoids tannin and saponins. The total phenolic and flavonoid content of pumpkin seeds were 130.09±0.03 mg GAE/100g and 89.35±0.13 mg QE/100g, respectively. The crude fat and protein content of pumpkin seeds were 24.75±0.02% and 27.99±0.01%, respectively. Overall acceptability of soup cubes was obtained by the ratio of 1:1 and, the pH, moisture content, ash content, fat content, and protein content of the best formula were 5.46±0.03, 7.51±0.13, 3.52±0.09, 5.33±0.22, and 15.53±0.35, respectively. In conclusion, incorporating pumpkin seeds flour enhances the protein content of soup cubes which make them a valuable protein source for vegetarians

Keywords: Functional food, Pumpkin seeds, Protein, soup cubes, vegetarians

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Green synthesis of AgNPs using Citrus aurantifolia extract and their application as a fabric coating to enhance the color, and anti-bacterial property

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Synthetic and natural organic compounds are widely used as textile dyes. However, color fading due to prolonged UV exposure is a major problem. Colored noble metal nanoparticles including silver nanoparticles (AgNPs) are stable upon UV exposure. Different colors can be formed by changing the size and shape of AgNPs. Reported herein is a novel development of multifunctioning AgNPs of various colors using the same precursor. AgNPs were synthesized using a green synthesis approach using lime (*Citrus aurantifolia*) juice extract, which acts as the reducing and stabilizing agent simultaneously. Different colors were obtained including yellow, orange, red, green, brown, and grey by changing the concentration of Ag^+, pH, temperature and the Ag^+/lime volume ratios. AgNPs were characterized by UV-vis spectrophotometer and SEM analysis. Characteristic localized surface plasmon resonance peak (λ_{LSPR}) at ~ 420 nm confirmed the formation of AgNPs. The wavelength shift (λ_{LSPR}) from 418-426 nm proved the formation of different sizes of AgNPs. Linen fabrics were colored using in-situ AgNP synthesis approach. FTIR analysis confirmed that the molecular structure of fabric is not affected by AgNPs. Functionalized fabric showed excellent antimicrobial activity against *Staphylococcus aureus* and DPPH assay analysis showed 70% antioxidant activity. Pyrrole-coated fabrics colored with AgNPs showed conductivity of 1.3 mS. Hence, the green synthesized AgNPs incorporate antibacterial, antioxidant, and conductive properties to the fabric while acting as a colorant resulting a multifunctionality which can be used in advanced textile materials.

Keywords: Antibacterial fabrics, Conductive fabric, Green synthesis, Silver nanoparticles, Textile dye,

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Synthesis of SiO_2 near-nano particles and biochar from rice husk for rice plant growth enhancement

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Rice husk (RH) is one of the most abundant agro-waste in Sri Lanka, and it is silica rich protecting cover of rice grain. Near-nano range (150 nm-200 nm) silica was synthesized using rice husk and applied as a foliar application for rice plants (*Oryza sativa L.*) in 0.5, 1.0, 1.5 and 2.0 mol/m^3 concentrations. Biochar was produced separately in oxygen limited conditions by pyrolysis of rice husk at 250, 350, 450, and 550 ℃ temperatures. The biochar synthesized at 350 ℃ was used for the soil amendment at 0.20, 0.25, 0.30 and 0.35 Kg/m^2 levels. The chlorophyll content, plant height, root weight, and root height were measured to assess the effect of foliar application of near-nano rice husk particles on plant growth. The rice plant samples treated with 1.5 mol/m^3 silica solution showed the best growth performance compared to the other samples, resulting in a 25 % increase in chlorophyll content. The plant treated with 0.25 Kg/m^2 level showed the highest growth performance. Subsequently, another 0.25 Kg/m^2 biochar added rice plants were treated with near-nano silica particles of above-mentioned concentrations. The treatment with 1.0 mol/m^3 level resulted in the highest growth performance, showing a 27 % increase in chlorophyll content. UV-Vis spectroscopic analysis, Particle size analyzer and FTIR data also confirmed the presence of near nanoscale particles. SEM images confirmed the morphology of Silicon dioxide and biochar that was pyrolyzed at 350 ℃. The study concludes that silicon dioxide near-nano particles and biochar significantly improved rice plant growth.

Keywords: Agro wastes, Near-nano silicon dioxide, Rice husk-based biochar, Rice plant growth, Rice husk

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Bioactive potential and industrial applications of compounds from endophytic fungi in *Prosopis juliflora* L.: Extraction, isolation, and characterization

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Prosopis juliflora L. (Mesquite) is a highly invasive plant in the Southern province of Sri Lanka, known for its symbiotic relationship with endophytic fungi. However, there has been limited research on these fungus secondary metabolites and potential industrial applications. This study investigates the secondary metabolites of endophytic fungi in *P. juliflora*, to explore their phytochemical properties and bioactive potential. After collecting plant samples, endophytic fungi were cultured and identified. The secondary metabolites extracted from these fungi were analyzed for their phytochemical content. Total phenolic and flavonoid contents were measured using Folin-Ciocalteu and Aluminum Chloride methods, respectively. Free radical scavenging activity was evaluated using the DPPH assay, while cytotoxicity was assessed using the brine shrimp lethality assay. Antibacterial activity was tested through the agar well diffusion method, and zinc and phosphate solubilization capabilities were determined using Zinc-agar and Pikovskaya's agar media assays. The identified fungi included *Penicillium* sp., three *Aspergillus* spp., and *Fusarium* sp. Phytochemical screening revealed the presence of alkaloids, phenols, tannins, saponins, flavonoids, terpenes, and sterols. Among the fungi, *Aspergillus* sp. exhibited the highest total phenolic content (37.22 mg GAE/g) and flavonoid content (13.27 mg QE/g), while *Penicillium* sp.2 showed the strongest free radical scavenging activity (55.15 ppm). The highest cytotoxicity was observed in *Fusarium* sp. All tested fungi inhibited the growth of *Bacillus* sp., a gram-positive bacterium. Additionally, *Penicillium* sp.1 and three *Aspergillus* spp. demonstrated zinc solubilization, while *Penicillium* sp.2 and three *Aspergillus* spp. solubilized phosphate. Pigment production was observed in *Penicillium* sp.2, and it was isolated and characterized using UV, FTIR, and TLC techniques, along with confirmatory tests. The pigment was identified as anthocyanin and used as a natural dye for coloring raw cotton fabric. These findings suggest that endophytic fungi in *Prosopis juliflora* are promising sources of bioactive compounds with medicinal potential, natural dyes, and biofortification strategies.

Keywords: Endophytic fungi, Invasive plants, phytochemicals, Zinc and phosphate solubility

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Value addition to rose water toner using biotransformed products formed with endophytic fungi in *Prosopis juliflora*

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Endophytic fungi have significant potential as sources for biotransformation. This study aimed to explore the ability of endophytic fungi to transform essential oils into valuable compounds that could enhance the properties of rose water toner. Limonene, a compound derived from the peels of *Citrus aurantium*, commonly considered a waste product, was used to study this biotransformation process. The limonene was extracted from the lemon peels via hydrodistillation and characterized using FTIR, UV, TLC, and confirmatory tests. Endophytic fungi were cultured from the root suspension of *Prosopis juliflora* and identified as *Penicillium* sp., three *Aspergillus* sp., and *Fusarium* sp. These fungi were inoculated with the extracted limonene from *C. aurantium* to analyze the biotransformation products using FTIR. The study aimed to improve the quality of natural rose water toner by adding both limonene and the biotransformed products of limonene separately. DPPH free radical scavenging assays and agar well diffusion assays were performed on the toner with limonene and the toner with the biotransformed limonene. The FTIR spectrum showed a peak at 3346.63 cm^{-1} in each biotransformed product, indicating the presence of one or more hydroxyl groups formed through the biotransformation of limonene. In the DPPH assay, the IC_{50} values were 174.85 mg/L for the toner with limonene and 167.50 mg/L for the toner with the biotransformed limonene product. Additionally, the toner containing the biotransformed limonene showed a 3 mm increase in inhibition zone diameter in the agar well diffusion assay compared to the toner with limonene itself. In conclusion, the inclusion of biotransformed essential oil to the toner enhances both its antioxidant and antibacterial properties. This study demonstrates that the biotransformation of natural products using endophytic fungi is an effective strategy to produce modified natural compounds in environmentally friendly conditions, offering promising value additions to industrial products.

Key words: Biotransformation, Essential oil, Endophytic fungi, Limonene, Rose water toner

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Evaluating the viability of utilizing waste cooking oil for laundry soap production

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Reuse of Waste Cooking Oil (WCO), poses hazards owing to its carcinogenic effect. Developing value-driven alternatives could divert WCO from the food industry. This study investigated the feasibility of repurposing WCO into laundry soap as a reuse strategy. WCO samples (7,500 mL, total volume) were collected from eight restaurants/households. Equal volumes (2,000 mL) were purified using Activated Charcoal (PAC) and heating with Water (PHW), while Pure Coconut Oil (PCO) and unpurified WCO were used as control and blank. Cold-process was employed for soap production, with commercial soap as a control. FT-IR analysis of functional groups in oil samples, Acid-value, Free Fatty Acids (FFA%), Peroxide-Value (PV), Viscosity, Density, Specific Gravity, Saponification-Value (SV), Moisture Content (MC%), and Iodine-Value for oil and pH, Total Alkali Content (TAC%), Total Fatty Matter (TFM%), and lathering for soap were also determined. All experiments were conducted in triplicates. Cleansing effectiveness of produced soaps was measured using (8 x 8 cm^2) stained cotton cloths (with wax, sauce and ash) subsequently washed under identical washing conditions and 1x1 cm^2 squared transparent sheet was used to determine stain patch removing percentage. FT-IR results showed consistent transmittance between WCO and PCO, confirming WCO's efficacy in soap production. PAC reported the highest oil quality, with the lowest (±SD) FFA% (0.006±0.005%), PV (1.468±0.291 mg KOH/g), and highest SV (235.548±16.538 mg KOH/g). PAC also produced superior soap quality, with significantly higher TFM% (82.635±3.963%). Further, PCO and PAC exhibited the best cleansing effectiveness at 34.3±1.743% and 31.3±5.75%, respectively. The study identified WCO as a viable raw material for soap production, while PAC was the optimal purification method. Further studies on cost-effective deodorizing and decolorizing agents are recommended to enhance soap quality.

Keywords: Activated Charcoal, Laundry soap production, Purification, Waste Cooking Oil

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An optimized level-dependent shrinkage function for an improved DWT-based ECG noise filter

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Electrocardiograms (ECGs) are vital tools in the diagnosis of cardiovascular diseases (CVDs). They are widely used by physicians especially because of the diagnosis accuracy, the associated lower acquisition costs, and the ease of acquisition. However, during the signal acquisition, ECGs can easily become contaminated by various types of noise interferences, which may lead to an incorrect diagnosis. Thus, noise-filtering the signals is essential for the reliable interpretation of ECGs. Compared to other ECG noise filtering methods, Discrete Wavelet Transform (DWT) based techniques have gained considerable research interest, especially during the past decades. In the literature, a relatively sophisticated level-dependent wavelet shrinkage function has been applied for DWT-based ECG noise filtering. Although the existing shrinkage function may offer fair performance in ECG noise removal, it still has certain limitations. Thus, in this paper, a more efficient level-dependent shrinkage function is proposed, optimized, and tested for its higher DWT-based ECG noise filtering performance compared with the existing function. The proposed level-dependent shrinkage function was optimized for its filtering performance through parameter estimation. For experimentally testing the performance of the filters, clean ECG signals were obtained from an online ECG database and then contaminated with simulated white Gaussian noise. Then, they were noise-filtered using the DWT-based filters developed using the proposed and existing wavelet shrinkage functions. The noise filtering performances of the filtered signals were estimated based on the output ECG signal quality. The experimental results indicate that the newly developed shrinkage function produces significantly cleaner ECG outputs, particularly in comparison to the existing function.

Keywords: Discrete-Wavelet Transform, Electrocardiogram, Shrinkage function

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Preliminary study on sound absorption in loosely packed wood chips with varying particle sizes

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This study explores the potential of organic materials for sound insulation by evaluating the Sound Transmission Coefficient (STC) of uniformly packed woodchips of three sizes. The research measures Transmission Loss (TL) through cubic enclosures filled with materials to determine STC. The materials are packed between two meshed cubes with dimensions of 60 cm×60 cm×5 cm, ensuring consistent packing density. A B&K type 4292 omnidirectional speaker, powered by a type 2734 amplifier, is placed at the center of the cube as the sound source. Sound Pressure Level (SPL) measurements are taken inside and outside the cube using a B&K type 2250 Sound Level meter and then averaged with measurements of four sides. The study uses pink noise ranging from 12.5 Hz to 20 kHz in one-third octave bands. TL and STC are independently calculated for wood-chips of three sizes. The findings show that TL is significantly influenced by particle size and sound frequency. Higher frequencies are notably attenuated across all samples. Frequencies above 400 Hz show higher attenuation for large wood-chips (mean area 0.346cm^2), above 160 Hz for medium-sized chips (mean area 0.154cm^2), and above 80Hz for wood-dust (mean diameter 0.003cm). The STC for loosely packed materials is highly dependent on particle size, with smaller particles more effectively absorbing vibrations and achieving higher TL, thus resulting in lower STC. The study shows that sawdust has an STC of less than 0.05, while large and medium wood-chips have STC ranging from 0.4-0.3 and 0.3-0.2, respectively. It concludes that loosely packed wood particles are an effective alternative for acoustic insulation.

Keywords: Acoustic, noise, organic materials, sound insulation, wood chips

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Noise pollution level in the heart of Matara city 2024

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A threat that is apparent but not seen lurks in the middle of Matara City's busiest streets and lively environment. In this rapidly urbanising center of Sri Lanka, noise pollution has become an invisible intruder, interfering with daily living and endangering public health. This study investigates the growing problem of noise pollution and how it affects urban life in the center of Matara City, Sri Lanka. The selected locations were chosen for their proximity to high-traffic areas and essential public institutions, ensuring a comprehensive understanding of noise exposure in areas where residents are most affected.

The traffic noise was measured for 3 minutes each hour from 9.00 am to 7.00 pm, over two days at nine locations. The noise level (L_{Aeq}) was recorded using a 2250 light (BZ - 7130) B&K hand-held analyzer with necessary calibrations mounted on a tripod about 1.2 m above the ground level, to reduce the Ground Effects, and positioned about 6-8m away from the middle of the road.

Throughout the research, the noise level at all places stayed between 69 - 81 dB, exceeding the National Environmental Act's suggested daytime levels of 50 dB for quiet zones like hospitals, public libraries, and schools, and 63 dB for urban areas. A broad approach is needed to control noise pollution in Matara City, including stricter traffic regulations as no-horn zones and encouraging large vehicles to operate during off-peak times. Adding green spaces and noise barriers also helps lower noise levels and create divisions between streets and residential areas.

Keywords: Matara city, Noise pollution, Noise control, Traffic noise

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Preliminary study of sound absorption in loosely packed coir fiber for building noise insulation

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The growing demand for eco-friendly building materials has increased interest in natural fibers for sound insulation applications. This study investigates the sound absorption properties of coir, a fibrous material derived from coconut husks. In this research, the Sound Transmission Coefficient (STC) of uniformly packed coir of two different-sized coir samples, packed uniformly, is examined. Here, we used cubic enclosures filled with the material. To ensure uniform packing density, the materials are sandwiched between two meshed cubes measuring 60 cm×60 cm and 5 cm thick. The sound source is a B&K type 4292 omnidirectional speaker positioned at the cube's center and powered by a type 2734 amplifier. A B&K type 2250 class 1 Sound Level meter is used to measure the Sound Pressure Level (SPL) both within and outside the cube, with average values obtained from four measurements. Pink noise in one-third of octave bands, from 12.5 Hz to 20 kHz, is used in the study's experiments. For two distinct sizes of coir, Transmission Loss (TL) and STC are independently computed. Large coir fibers exhibit minimal attenuation at frequencies below 400 Hz, while medium-sized coir shows minimal attenuation below 500 Hz. This occurs because lower-frequency sound waves traverse large coir gaps, minimizing scattering and absorption. The Sound Transmission Coefficient value is close to 1 below 400Hz and ranges from 1 to 9 above 400Hz for both samples, indicating better sound insulation and absorption at frequencies above 400Hz. This study concludes that coir material provides effective sound insulation within this frequency range.

Keywords: Coir, sound transmission coefficient, sound insulation, transmission Loss,

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Development of a smart electrochemical potential measuring system

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Potentiometry is a key analytical technique in electrochemistry, where the potential in terms of the voltage of an electrochemical solution is measured without drawing significant current from the source. This measurement is widely used in chemical, biological, and industrial applications. Analytes like pH (H+ ions), chloride (Cl-), fluoride (F-), and other concentrations can be precisely measured by sensing the potential difference between electrodes using potentiometry. It is frequently applied to acid-base titrations, in which the reaction's endpoint is determined by monitoring pH levels. However, the cost of electrodes and potentiometer devices limits this measurement's usage, and a smart electrochemical potential measuring system is required. Therefore, we have developed a smart potential measuring device based on Arduino integrated with a real-time data analysis graphical user interface (GUI). The potential measurements are directly fed to the Android mobile application through Bluetooth and real-time calculations are performed. The electronic system consists of an Arduino Uno, an Instrumental Amplifier (AD620), a Voltage sensor, and a DC/DC voltage regulator. The GUI was written using “React Native”. Using GUI, the user can plot data in graphical format in real time and calculate the pH value. The potential measurements of the system have an accuracy of ± 0.1 mV. The developed system is user-friendly, accessible and reliable due to its simplicity, low-cost and high accuracy.

Keywords: Arduino, Electrochemistry, Graphical User Interface, Potentiometry

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Preliminary analysis of the social impacts of flooding in the southern province of Sri Lanka from 2011 to 2020

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Floods have become a major natural hazard in Sri Lanka. The main objective of this study is to analyze the flood distribution patterns and their severity across the southern province of Sri Lanka, focusing on the Matara, Galle, and Hambantota districts. While previous studies have examined the social impacts of floods in some selected parts of Sri Lanka, this is the first study specifically conducted in the southern province. The analysis covers four seasons: the Northeast Monsoon, the First Inter-Monsoon, the Southwest Monsoon, and the Second Inter-Monsoon, using data sourced from the Disaster Management website. The data was processed using Excel and Minitab software to plot graphs of human impacts, residential impacts, and indirectly affected populations every month. The study spans ten years, from 2011 to 2020, and examines the wide-ranging impacts of floods on the lives and economy of Sri Lanka, including the disruption of daily activities, tourism, and economic growth. The Southwest Monsoon was found to have the most significant impact on flooding in the southern province, with Matara experiencing the highest impact, Galle moderate, and Hambantota the least. The most severe flooding occurs in May. However, the Galle district residential impacts show the highest value in September. By identifying the peak months for floods, this analysis offers valuable insights for implementing effective flood risk mitigation strategies, contributing to a safer and more resilient society.

Keywords: Flood, Monsoons, Southern Province, Severity, Ten years

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An optical method for estimating the concentration of sugar solutions

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The refractive index of a solution varies with the concentration of dissolved sugar, and this property can be leveraged for precise concentration determination. The concentration of sugar solution was estimated using a hollow prism made of Acrylic, a spectrometer, and a Sodium lamp as the light source. The hollow prism was filled with standard sugar solutions with concentrations ranging from 0% to 60% (weight/weight), and a sodium light beam was allowed to pass through it. The refractive index of each solution was measured using the spectrometer which is sensitive enough to detect changes as small as 0.07%. The measurements were used to construct a calibration curve correlating the refractive index with sugar concentration. A strong relationship between refractive index and concentration was observed through the range 0% - 60%, with an R^2 value of 0.9999 and a Mean Absolute Percentage Error (MAPE) of 0.42%. Naturally available sugar solutions such as Saccharum officinarum (Sugar cane), Ananas comosus (Pineapple), Citrullus lanatus (Watermelon), Cocos nucifera var aurantiaca (King coconut), and Citrus sinensis (Orange) were tested for their sugar concentration using the proposed method and their sugar concentrations were measured as 12.34%, 9.16%, 6.31%, 5.14%, and 6.96%, respectively. These results are aligned with values reported in various reference studies, confirming the method's reliability. It can be used to estimate the concentration of sugar solutions within the range of 0% - 60% with an average accuracy of 99.5%.

Keywords: Calibration curve, concentration of sugar solutions, optical method, refractive index

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Treatment of wastewater generated from batik industry by fenton oxidation - A laboratory study

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The production of batik, a traditional method of dyeing textiles, generates wastewater that is highly contaminated with chemicals, dyes, and suspended and dissolved particles, posing serious environmental risks. Fenton oxidation, an advanced oxidation process (AOP) that effectively breaks down complex organic contaminants, has become a potential treatment option for such wastewater. This study focuses on optimizing key process parameters, including pH levels (2, 3, 4, 5, 6), H_2O_2 concentrations (44.09, 102.89 161.69, 220.49, 279.29 mmol/L), $FeSO_4 \cdot 7H_2O$ concentrations (400, 1000, 1600, 2200, 2800 mg/L), and reaction durations (30, 60, 90, 120, 150 minutes) in order to maximize pollutant degradation. It also examines their effects on the reduction of total suspended solids (TSS), colour, and chemical oxygen demand (COD). All experiments were conducted using the response surface methodology, with a central composite design employed to optimize dye degradation under Fenton conditions. The optimum operational conditions were determined as 231.77 mmol/L of H_2O_2, 400 mg/L of $FeSO_4.7H_2O$, pH 2, and 150 minutes of retention time. The colour removal under these conditions was greater than 98%. Based on experimental data, Fenton oxidation makes a significant reduction in the colour, TSS, and COD of batik wastewater. The study concludes that Fenton oxidation is a viable and efficient treatment method for batik wastewater, offering a sustainable solution to the environmental challenges posed by the textile industry. Further research on scaling up the process and integrating it with other treatment technologies could enhance its applicability by reducing some drawbacks.

Keywords: Advanced oxidation, Batik wastewater, Fenton oxidation

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Determination of naphthalene and phenanthrene concentrations in meandering part of the Kelani river basin, Sri Lanka

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Naphthalene (NAP) and Phenanthrene (PHE) are carcinogenic and ubiquitous Polycyclic Aromatic Hydrocarbons (PAHs) that are daily leached into water bodies as a result of anthropogenic activities. This study explores the detecting naphthalene and phenanthrene contamination in both water and biological samples in meandering part of the Kelani River Basin, where the water pollution is considered to be high. Water Samples were collected from 13 location (n=3) within two seasons. Concentrations of NAP and PHE were investigated using High-Performance Liquid Chromatography (HPLC) analysis, after organic solvent extraction. HPLC analysis gave admirable recovery percentages for water phenanthrene (89 ± 2.6%) and naphthalene (86 ± 4.1%) and for fish phenanthrene (85± 1.6%) and naphthalene (82 ± 3.2 %) respectively. The findings of the study showed a significant range of NAP concentrations in water spanning from 2.499 to 8.414 (mg/L) in wet season and 0.005 to 9.658 (mg/L) in dry season, where PHE concentrations vary from undetectable to 0.248 (mg/L) during the wet season and undetectable to 0.329 (mg/L) in dry season. The distribution pattern of NAP was greater than PHE for both water and fish samples. The high concentrations of PAHs might be due to high oil and grease content caused by infrequent oil and sludge spills from nearby industries, tributary inflows. This study provides valuable information for environmental monitoring programs and contribute to the development of effective strategies to mitigate the PAH pollution in meandering part of Kelani River Basin, Sri Lanka. Broder studies are recommended to pinpoint the sources of PAHs and explore strategies for minimize the environmental emissions.

Keywords; Kelani river basin, Naphthalene, Phenanthrene, Polycyclic Aromatic Hydrocarbons, HPLC

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A study on using industrial footwear offcuts in composite fabrication for secondary applications

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The footwear industry generates significant offcut waste, primarily from leftover materials during manufacturing, which poses various environmental challenges. This study focuses on the repurposing of shoe lining waste, composed of materials such as white tricot fabric, thermoplastic polyurethane, polyester fabric, bright orange spice spacer and various types of foam. A total of 25 g of this offcut waste was utilized to create composite layers for diverse applications. To optimize composite formation, various binders and solvents were tested to enhance solution viscosity, allowing for uniform spraying while maintaining the binding properties. An improved binding solution was developed by mixing 120 g of Multibond 364 footwear adhesive with 200 ml of dichloromethane (CH_2Cl_2). A mold measuring 12 cm by 12 cm was employed for the composite layer. Initially, 12.5 g of the offcut waste were placed in the mold. Half of the adhesive solution was then uniformly sprayed onto this layer, followed by the addition of the remaining offcut waste and the application of the rest of the adhesive solution. A pressure of 5 N was applied to ensure proper bonding, and the composite was allowed to cure at room temperature for 120 hr. The resulting composite layer, with a density of 0.19625 g cm^{-3}, demonstrates promising potential for applications such as seat cushions, packaging material, and other uses, effectively contributing to waste reduction and sustainability in the footwear industry.

Key words: Composite layer, Dichloromethane, Offcut waste

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A personalized hair shampoo recommender system based on hair type and condition using graph theory

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People prioritize the personalized approach to beauty care and the need for unique cosmetic products. This paper suggests how graph theory can be used to optimize the recommendation of hair shampoo cosmetic products to increase the satisfaction of the users and the suitability of the hair shampoo products. We present an approach using three bipartite graphs: product-ingredient graph, user-product interaction graph, and hair type/condition-ingredient graph. All the above graphs have a particular use, and their combined function is to make the system more effective and individualized in enhancing product suggestions for a user. The merged graph of these three graphs produces more extensive and specific hair cosmetic suggestions. We recommend suitable hair shampoo products by analyzing the merged graph drawn by Cytoscape software using the method of node centrality measures. The node with the highest degree is the best option. We use the same process to identify the ideal hair type and condition for a shampoo product. To validate the method user feedback can be used to assess user satisfaction regarding the suggested shampoo product and observed outcomes over a defined period. This method guides users to select the best shampoo product with knowledge. It can be applied to other domains of the beauty industry such as skincare, makeup, and other haircare products. It could be explored in future research.

Keywords: Hair Type/Condition-Ingredient Graph, Hair shampoo recommendation, Product-Ingredient Graph, User-Product Interaction Graph

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Graph theory analysis of human physiology: Ranking human body systems, organs, hormones, and effects

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This study is a result of focusing on the situations where graph theory can be used and has not been applied in common previously. The objective of this study is to provide a summarized knowledge of important body systems, organs, hormones, and effects on the body by ranking them. This study investigates the complex connections between human body systems, organs, hormones, and their physiological effects by using the aspects of graph theory. A 4-partite directed graph was constructed to represent these connections and rankings were done by using the authority and hub values. The analysis identified regulating metabolism as the most influential physiological effect, generated by the largest number of hormones. The hypothalamus is identified as the major organ, producing the greatest number of hormones. The Epidermal growth factor was found to be the most widely produced hormone, while the endocrine system was recognized as the leading body system in hormone production. Even though this study provides valuable insights, it is essential to note that the results are dependent on the scope of data and inherent complexities in human physiology, suggesting the requirement for further research.

Key words: Hormones, Organs, Human body, Authority and Hub, 4- partite Directed Graph

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Estimation of value at risk of portfolios: Empirical evidence from Colombo stock exchange

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This study estimates and compares the Value at Risk (VaR) of portfolios using three methods: Historical Simulation, Variance-Covariance, and Tukey's g and h distribution. Four portfolios, each valued at Rs.1,000,000, were constructed using S&P SL 20 index securities from the Colombo Stock Exchange (2018–2023) and categorized by mean closing price quantiles. Results show that Tukey's g and h method performs optimally at higher confidence levels, while the Variance-Covariance method is more effective at lower levels. Portfolios with securities priced above Rs.76.68 yielded the lowest VaR, emphasizing the importance of security selection in risk management. These findings provide practical insights for portfolio optimization and risk management in emerging markets. However, limitations, such as reliance on historical data, warrant cautious application.

Keywords: value at risk, Tukey's g and h distribution, historical method, variance covariance method

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Logistic function as a forecasting model for product diffusion

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It is essential for businesses to understand how quickly their new products will be adopted, especially in fast-changing technology fields. In this research, we use the logistic function to predict product adoption over time and develop a product diffusion model based on it. We applied this model to historical data on fixed broadband subscriptions in Sri Lanka. The key parameters of the logistic function: maximum market size K, growth rate r, and the time at which adoption accelerates the most t0 were estimated using Non-Linear Least Squares (NLS) optimization. To improve accuracy, we developed the logistic model by replacing its constant growth rate parameter with a time dependent polynomial function and refitted it for different degrees of polynomials. After removing outliers using the interquartile range (IQR) method based on residuals, we re-estimated the parameters and evaluated the performance of both the initial and developed models. We found that the degree two polynomial provided the best fit. When comparing the developed model with the initial model, the R-squared value increased from 0.997 to 0.999 and the mean absolute error decreased by approximately 69.5%, indicating a better fit for the developed model. This study suggests that businesses can use this developed model to plan better marketing campaigns, manage resources, and prepare for when their product reaches market saturation. This study improves on traditional logistic models by making the growth rate change over time, offering a better way to predict product adoption in dynamic markets.

Keywords: Logistic function, Product adoption, Forecasting, Broadband

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Hybrid optimization method combining revised ant colony algorithm and geometric mean to solve the traveling salesman problem

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The Traveling Salesperson Problem (TSP) is a classical optimization problem which aims to find the shortest possible path for a salesman to visit each city exactly once and return to the starting point. The TSP has been solved using a variety of techniques, including heuristic approaches like genetic algorithms, simulated annealing, and ant colony optimization, as well as exact solution techniques such as the Brute Force algorithm, branch and bound, and dynamic programming. While exact methods guarantee optimal solutions, they are often computationally expensive, making heuristic algorithms more practical.

We introduce a hybrid optimization method that combines a revised form of the Ant Colony Algorithm with Geometric Mean to solve the TSP efficiently. Unlike traditional algorithms such as Ant Colony Optimization and Genetic Algorithms, which rely on multiple iterations to approximate the solution, proposed method avoids iterative computations while providing near optimal solutions in most cases. Furthermore, compared to exact methods like the Brute Force algorithm, the proposed method reduces the solution space by categorizing edges. This categorization allows the algorithm to focus only on promising edges, thereby enhancing computational efficiency.

The main steps of the proposed method are as follows: first, the distance matrix's geometric mean is computed; next, the pheromone probabilities for each edge are determined using the geometric mean; the probabilities are then arranged in ascending order; next, primary and secondary edge selectors are chosen; and last, edges are added to the optimal path under certain conditions. An elaborate example is given to demonstrate the suggested approach.

Keywords: Traveling Salesman Problem (TSP), Geometric Mean, Ant Colony Algorithm, Heuristic Methods

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An improvement of the restructured Vogel's approximation technique for both balanced and unbalanced transportation problems

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In logistics and supply chain management, the transportation problem is a basic challenge that involves minimizing the cost of moving goods from various sources to destinations. These problems can be broadly categorized into balanced and unbalanced types, which are the primary focus of this research. To find an initial basic feasible solution, one can employ various methods such as Least Cost Method, Vogel's Approximation Method, Row Minima Method, Column Minima Method, and North-West Corner Method. Methods such as the Stepping Stone Method and the Modified Distribution Method are often used to determine the optimal solution. In this research, we propose an improved approach for solving the transportation problem using a modified Vogel's approximation method, incorporating arithmetic averages to improve solution quality. First, we check whether the given problem is balanced or unbalanced by comparing the total supply and demand. If it is an unbalanced transportation problem, a dummy row or column is added to convert it into a balanced form. Then we calculate row and column averages, then determine penalty costs by finding the difference between the closest minimum and maximum values of these averages. Finally, we allocate by choosing the row or column with the highest penalty cost and assigning the maximum possible amount to the cell with the lowest cost in that row or column. The benchmark problems demonstrate that the proposed method achieves higher accuracy compared to the existing modified Vogel's Approximation Method.

Keywords: Initial Basic Feasible Solution, Logistics and Supply Chain Management, Optimum Solution, Transportation Problem, Vogel's Approximation Method

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One dimensional cutting stock problem using the decreasing even-odd method

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The literature confirms that different approaches have been suggested previously to solve the Cutting Stock Problem (CSP). While the remaining techniques seek to find the best solution to the CSP, some like the heuristic, metaheuristic and exact methods concentrate on finding a best solution. The primary objective of the CSP is to determine the most efficient cutting pattern that satisfies demand while minimizing material waste and production cost. CSP methods are broadly classified based on dimensionality, and this work addresses the one dimensional cutting stock problem using a new method as the descending even-odd method. The first step in this method is to arrange all of the pieces in descending order .The selection alternates by placing the largest even numbered piece first, followed by the largest odd numbered piece, then the second largest even piece and so on. Comparative analysis revealed that the proposed method performed better than first fit, best fit and next fit algorithms by providing more effective solutions in terms of material use and waste reduction. The proposed study is less complicated compared to the well-known other existing CSP algorithms. In addition, future studies could look into applying this technique to bigger datasets using programming languages in order to confirm its suitability and assess how well it works in various contexts.

Keywords: Cutting Stock Problem, Descending even-odd method, Heuristic, One dimensional

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A novel upper bound of Ramsey number $R(3,11)$

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Ramsey numbers are a fundamental concept in graph theory. Their existence was first proved in 1930. Those studies focus on determining the exact values for Ramsey numbers and improving upper and lower bounds. The Ramsey number; $R(s,t)$ is the least positive integer n such that a complete graph of n vertices has either a complete subgraph of size s or its complement has a complete subgraph of size t. Since finding the exact values of Ramsey numbers is a challenge with increased number of vertices, an upper bound has been introduced. The progress made in the last 50 years in finding the values of $R(3,t)$ is remarkable. Through this work, our objective is to introduce a tighter upper bound for $R(3,11)$ than the existing. We consider graphs G with n vertices and e edges that do not contain a complete subgraph of size s and a complete subgraph of size t in the complement, denoted by $(s,t;n,e)$-graph. Under the Neighborhood Gluing Extension Method, any K_3-free graph on n vertices with e edges without K_{t+1} in the complement can be produced by using any K_3-free graph on m vertices without K_t in the complement. Let's consider the graph G which is a 10-regular K_3-free graph of 49 vertices with 245 edges without having K_{11} in G^c. The conjecture is the existing of G in K_3-free graph of 38 vertices with 145 edges without K_{10} in the complement. By this conjecture, we can conclude a new upper bound of $R(3,11)$ as 49.

Keywords: Ramsey numbers, Upper bound, Complete subgraph, Neighborhood Gluing Extension Method, Regular graph

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Optimizing skolem sequence generation: python implementations for standard and hooked forms

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Skolem sequences, introduced by Thoralf Albert Skolem in 1957 to solve Heffter's difference problems, consist of sequences of 2n integers derived from pairs of positive integers between 1 and n. In these sequences, each integer k appears exactly k positions apart. Later, Skolem extended this concept by introducing hooked Skolem sequences, a generalization used to construct various combinatorial designs. These sequences have garnered attention in different fields, including graph theory and combinatorial design, with applications ranging from graph labeling to the factorization of complete graphs. However, existing generation methods for these sequences are often time-consuming and require substantial storage resources. Therefore, developing a more efficient process for generating both standard and hooked Skolem sequences is essential. Unlike traditional permutation-based methods, the novel approach needs to utilize techniques that significantly reduce the computational time. In this study, we developed two optimized Python implementations for generating both standard and hooked Skolem sequences. Our results show a substantial performance improvement, with computation time reduced by nearly half, especially for larger values of n. Additionally, we exploit the property that the reverse of a Skolem sequence is also valid, further enhancing the efficiency of the generation process. This improvement enables researchers to focus more on solving key problems rather than the sequence generation itself. Furthermore, these Python scripts can be adapted and extended to generate other types of Skolem-related sequences.

Keywords: Skolem sequences; Hooked Skolem sequences; Combinatorial design; Algorithm optimization; Python programming

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Optimal impulsive immunotherapy strategies for cancer through a mathematical model

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Immunotherapy, Chemotherapy and Radiotherapy are the main treatments for cancer. The role of immunotherapy is to increase the patient's immune system by manipulating the immunological environment. The main aim of this research is to investigate the optimal impulsive Immunotherapy strategies using an existing mathematical model for cancer growth. This optimization is done such that the number of tumor cells at the terminal time and the total cost of released infusion dose are minimized. The optimal treatment strategies are obtained in three categories, optimization by release amount of fixed infusion dose for given release period, optimization by release timing for given release amount of infusion dose and optimization by both release timing and release amount of infusion dose (mix optimal control). By applying a time re-scaling technique and Pontryagin's maximum principle, the optimal treatment strategies are obtained under the above three categories. Key findings show that optimization by release timing is more important than the optimization by release amount of fixed infusion dose, while the optimization by both release timing and release amount of infusion dose has the best comprehensive effect. In the future, this method will be expected to be used for Chemotherapy and Radiotherapy to control the cancer.

Keywords: Immunotherapy; Optimal Control; Impulsive Optimal Control; Cancer Treatment

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A novel transposition cipher leveraging RSA cryptosystem and Euler's totient function

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Cryptography is the process of transmitting sensitive information through secure networks while assuring its confidentiality, integrity and authenticity. To achieve this, many cryptosystems use well-established cryptographic algorithms to encrypt and decrypt messages. In this study, we utilize a well-known asymmetric algorithm known as the RSA algorithm with the integration of Euler's totient function, $\phi(n)$, which counts the number of positive integers less than or equal to n that are relatively prime to n. We select two prime numbers N and M such that $n = NM$ is neither an even number nor a multiple of 5, which constitutes for the existence of the modulo inverse. Then $\phi(n)$ was calculated and a value "e" was selected such that $\gcd(e, \phi(n)) = 1$. Once the ASCII (*American Standard Code for Information Interchange*) value of each character in the plaintext is determined, we can encrypt each character using $C \equiv p^e \ \phi(n) \bmod(n)$. To decrypt, we reverse the process using an inverse modulo $\phi(n)$. We calculate "d" satisfying $de \equiv 1 \bmod(\phi(n))$ and decrypt using $P(\phi(n)^d) \equiv \ c^d \bmod n$. To calculate P we need to find the inverse of $\phi(n)$ under modulo n. The use of ASCII values in conjunction with the RSA algorithm and Euler's totient function significantly increases the computational complexity of our encryption scheme. Our results indicate that while the cipher retains the foundational principles of RSA, it introduces an additional layer of security through character encoding. This enhancement makes it more challenging for potential attackers to decipher messages without the knowledge of specific primes used in key generation. The implications of this novel transposition cipher extend beyond our current findings as they pave the way for future exploration into advanced cryptographic techniques.

Keywords: ASCII values, Euler's totient function, Modular Arithmetic, RSA algorithm, Transposition cipher

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Enhancing flood forecasting in the Nilwala river catchment: A HEC-HMS approach

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Flooding is a major risk in tropical regions, with Sri Lanka especially vulnerable due to its vast river network. The present study examined the Nilwala River catchment in the Southern Province, a region experiencing recurrent flooding intensified by climate change and rainfall variability. To enhance flood forecasting, we developed a model using Hydrologic Modelling System (HEC-HMS version 4.11), incorporating daily rainfall and runoff data. The model was calibrated with 2017 data and validated using 2012 and 2019 datasets. Key methodologies included the Deficit and Constant methods for loss estimation, the Clark Unit Hydrograph for transformation, and Muskingum routing for flow dynamics. Performance metrics demonstrated model robustness, achieving a Nash-Sutcliffe Efficiency (NSE) of 0.67, Percent Bias (PBIAS) of 4.75, Standard Deviation Ratio (RSR) of 0.66 and Coefficient of Correlation (R^2) of 0.62 during calibration. Validation results showed consistent predictive capabilities, though extreme flood events were slightly underestimated. Predictions closely aligned with observed data at the Pitabaddara gauging station, effectively identifying peak flood occurrences. To improve flood management, we recommend detailed flood frequency analyses and installing a river gauge at the river's mouth for real-time data collection. This study underscores the model's potential to improve flood forecasting in the Nilwala River catchment, contributing to more effective flood risk management amid changing rainfall patterns. These advancements align with Sustainable Development Goal 11: Sustainable Cities and Communities, promoting resilience and sustainability in flood-prone regions.

Keywords: Flood forecasting, HEC-HMS, Rainfall variability, Nilwala River, SDG-11.

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An application of binary linear programming: A case study of preparing a weekly timetable for lower secondary grades (Junior Section) in a school in Sri Lanka

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This study explores how creating school timetables can be improved using Binary Linear Programming (BLP) techniques. A review of the literature revealed that various studies worldwide have addressed timetabling challenges using optimization techniques. As yet, no mathematical model has been proposed for school timetables in Sri Lanka. Though it is the current practice, manual preparation of timetabling is difficult as it takes time to balance teachers' workload and schedule subjects to benefit both students and teachers. Automating the timetable preparation for schools is essential, which is this study's main objective. The prominent characteristic of school timetabling is that it varies from school to school due to the different types of environments of schools. So as a result, it is not possible to provide a unique timetable for every school. This study provides a binary programming model based on a case study for Grade 6 classes in a school with 6 parallel classes (one English-medium class). While imposing subjects and teachers' requirements of the school as constraints, this model considers maximizing assigning key subjects, such as mathematics and science, which are difficult for students to study, in the morning periods, and other subjects, such as information technology and library, in the late periods. The *intlingprog* function of MATLAB programming language is used to solve the problem. We obtained the timetable for each of the Grade 6 classes considered as the case study. By imposing additional requirements as constraints, our model can be used to generate the timetables for other classes as well as for the other schools. This study shows how binary linear programming models can help school management generate timetables, improving the overall quality of timetabling while making the process faster and more accurate.

Keywords: School Timetables; Binary Linear Programming (BLP); Optimization Techniques; intlingprog function

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An application of mixed integer nonlinear mathematical programming for SAR model in time series analysis

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Mathematical programming models are proposed to obtain accurate forecasted values for time series models. The majority of forecasting methods involve estimation of parameters by minimizing the sum of squared errors. In this study, we proposed a integer nonlinear programming model that minimizes a combination of Akaike Information Criterion (AIC) and absolute errors to increase prediction accuracy. It uses the SAR (Seasonal Autoregressive) model with seasonal and non-seasonal autoregressive terms, allowing flexible choice of lag terms. Binary decision variables are used to determine whether specific lags are included in the model, optimizing the selection of autoregressive terms. The obtained mixed integer nonlinear programming problem is solved using the fmincon function implemented in MATLAB software package. The model is tested in a case study to forecast inflow to the Udawalawa reservoir considering the time series inflow data from January, 1996 to December 2020. We compare predicted values with other models; normal average, Holt-Winter, Fourier, SARIMA, and Facebook Prophet, and the proposed model outperforms these for the case study considered. The enhanced method significantly improves forecasting, especially for complex datasets. Mean absolute error and Root mean squared error are considered as the error matrices for comparing the models. The results indicate that this new mathematical programming method can significantly improve the performance of forecasting models, providing more accurate and reliable predictions for practical applications.

Keywords: Mathematical Programming, Time Series Forecasting, Optimization, Autoregressive Models, Akaike Information Criterion (AIC)

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A python-based method for labeling alkane graphs gracefully

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Graceful labeling, a concept introduced by Alexander Rosa in 1967, plays a significant role in graph theory. It involves assigning distinct integers to the vertices of a graph in such a way that the edges are uniquely labeled based on the absolute differences between the numbers assigned to adjacent vertices. This labeling scheme must ensure that both the vertex labels and the edge labels lie within a specified range, thereby fulfilling the necessary conditions for graceful labeling. The present study specifically focuses on the graceful labeling of alkane graphs (C_nH_{2n+2}). The main goal is to see if these graphs can still keep their gracefulness even when their structure changes. To achieve this, a Python program was developed, enabling the automation of the graceful labeling process for various alkane graph structures. The program introduces a parameter representing any positive integer, which allows the systematic generation of multiple graceful labeling configurations for the same graph. Through this computational approach, the study showcases the possibility of altering the number of carbon atoms of an alkane while preserving their graceful labeling. This research combines graph theory with computational methods, providing new insights into alkane graphs and their potential applications. The ability to systematically generate and analyze graceful labeling introduces new possibilities for applying graph theory to practical challenges, particularly digital security. Python programs can design cryptographic tools using flexible labeling methods, enhancing data security. Results show alkane graphs retain gracefulness despite structural changes, highlighting their potential for cryptography through unique labeling to innovate secure data applications effectively.

Keywords: Alkane, Cryptography, Graceful labeling, Graph theory, Python.

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Selecting students for a scholarship program using goal programming techniques: A case study

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This study is intended to develop a goal programming model for selecting students for a scholarship program based on a case study of a scholarship program offered by the Faculty of Science, University of Ruhuna, Sri Lanka. This paper addresses the automated procedure in selecting students for a scholarship program. For this purpose, we developed a binary linear goal programming model that could be used to enhance the student selection process for a scholarship program. When selecting students for the scholarship program, factors such as the number of siblings at school and university, the family's monthly income, the health conditions of the family members (especially parents), and the type of financial aid that has been granted are considered Bursary or Mahapola are considered by the scholarship committee at the Faculty of Science, University of Ruhuna. For each category, weights are assigned, and then each applicant's marks are calculated. Since in each category, allocated marks are in different scales, we used a transformation to convert marks in each category into the same scale. Then a goal programming model is developed to select the number of students assigning relative weights according to the importance of each category considered. The proposed binary linear goal programming model is solved using the branch and bound algorithm implemented by the MATLAB optimization toolbox. For the case study considered, 12 students were selected out of 90 students. The proposed model can be implemented to select students with more transparency, equity, and efficiency for scholarship programs.

Keywords: Optimization Model, Goal Programming, Student Selection, Scholarship Program, weights

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Enhancing coffee arabica quality using bayesian optimal experimental design approach

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Coffee is one of the most widely consumed beverages globally, including in Sri Lanka. Arabica coffee, accounting for over 60% of global production, is prized for its superior quality. However, leading producers like Ethiopia face challenges in maintaining quality due to evolving environmental conditions and market demands. This study applies Bayesian parameter estimation to identify key factors influencing coffee quality. Unlike traditional methods focused on regression coefficients, this approach evaluates utility based on predicted future data. A multiple linear regression model was fitted to 206 data points from an Arabica coffee dataset obtained from Kaggle. The dataset included aroma, flavor, aftertaste, acidity, body, and balance. Prior knowledge from historical data was incorporated into the Bayesian framework. The optimal set of covariates, defined as the optimal design, was assessed using the Kullback-Leibler Divergence (KLD) utility function, which quantifies the information gain between prior and posterior distributions. Since expected utility lacks a closed-form solution, Monte Carlo integration was applied, with Laplace approximation simplifying repeated posterior estimations to enhance computational efficiency. The Approximate Coordinate Exchange Algorithm was used to optimize the design, starting with three initial random designs for each scenario and iteratively removing covariates. The optimal design was selected as the one that maximizes the expected utility. In conclusion, the analysis identified "aftertaste" as a critical factor influencing overall coffee quality. This study highlights the efficacy of Bayesian regression and optimization techniques, which extend beyond traditional approaches that rely solely on regression coefficients, to systematically prioritize key factors that contribute to the enhancement of Arabica coffee quality, thereby supporting the maintenance of high standards and improving customer satisfaction.

Keywords: Approximate Coordinate Exchange, Coffee arabica, KLD utility, Laplace approximation

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Influence function-based confidence interval for survival probabilities by using Kaplan-Meier M-estimators

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This study presents a robust statistical framework for survival analysis using Kaplan-Meier M-estimators to estimate survival functions and construct confidence intervals. The proposed M-estimation approach demonstrates improved resistance to outliers and greater efficiency compared to standard methods like Greenwood's confidence interval, particularly under conditions of high censoring. Simulation studies reveal that M-estimators achieve superior coverage probabilities and more precise survival estimates. However, computational challenges remain when handling large datasets due to the complexity of high-dimensional optimization. This framework provides valuable tools for practitioners dealing with censored data, such as in medical research, and lays the groundwork for further advancements in robust survival analysis. Addressing computational scalability in future research will expand its applicability to larger datasets.

Keywords: Kaplan-Meier estimator, M-estimators, survival analysis, confidence intervals, censored data

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Cybersecurity awareness among Sri Lankan state university students: A cross-stream analysis

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Cybersecurity includes the safeguarding of systems, networks, and data from digital assaults, unauthorized access, and harm. This study aims to evaluate the existing level of cybersecurity knowledge among the university students in Sri Lanka. Data were gathered via a questionnaire given to 172 students across four academic disciplines: Management, Technology, Engineering, and Medicine. The findings indicate a significant deficiency in cybersecurity awareness among Medicine and Management students, whereas students in Technology and Engineering disciplines have a better understanding of the topic. A literature review of 27 research papers was also carried out. The existing literature indicates that university students in other countries, especially those in science and engineering disciplines, demonstrate a high level of cybersecurity awareness. According to the survey results, Engineering and Technology students exhibited greater expertise but also experienced cyber-related risks more frequently, with malicious links and spam being the most common threats. Significantly, these students possessed adequate information to identify such links as harmful. Nevertheless, the majority of students were unsure if they had experienced other forms of cyber risks. Moreover, the findings reveal that students in the Medicine and Management disciplines infrequently updated their passwords for online platforms. In summary, a considerable proportion of Medicine and Management students at Sri Lankan universities exhibit insufficient cybersecurity awareness and are vulnerable to cyber threats. They demonstrate a strong desire to acquire further knowledge about the issue. Conducting awareness sessions and workshops can improve cybersecurity practices among students, irrespective of their academic discipline.

Keywords: Cybersecurity, Cyber threats, Hacking, Security Practices, Social media

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Topography identification using multilevel thresholding and genetic algorithm

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Aerial images have vast amounts of details and structures and can be overwhelming during analysis. Thresholding reduces the range of color intensities which eases the structural identification process of topography aerial images. Multiple thresholds are required to distinguish terrain with varying pixel intensities from topography images. Multilevel image thresholding while maintaining image quality was the study of focus. A key objective was to use the genetic algorithm to achieve multilevel thresholding capabilities to improve topography identification. A sample aerial image was utilized for algorithm testing and evaluation. The method required the image to be converted to grayscale. Compared to the traditional Otsu method the newly developed algorithm uses the between class variance as the fitness function for the genetic algorithm. The individual selection was done through the roulette wheel selection method. The thresholding was performed for the grayscale histogram and thresholds were applied to the images using the algorithm. Three metrics were used for the evaluation of the algorithm performance and parameter determination, namely: Peak signal-to-noise ratio (PSNR), Structural similarity index (SSIM), execution time. SSIM was selected as the suitable method for evaluation since it evaluates the structural details of the image. Optimal parameters were population size of 100, generations of 100. Threshold of 5 selected as the optimum threshold which gives optimal SSIM of 0.84. Which also has a relatively low execution time of 171.8 seconds. The final thresholded image and threshold histogram is output from the algorithm which can be used for many computer vision tasks.

Keywords: Genetic algorithm, Image thresholding, Machine learning, Otsu's method, topography

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Design of high efficient corrosion resistant heat exchanger for Closed Cooling Water (CCW) system

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Heat exchangers in Closed Cooling Water (CCW) systems often face challenges such as corrosion, fouling, and reduced thermal efficiency, particularly in coastal environments. This project presents the design and optimization of a high-efficiency, corrosion-resistant heat exchanger to address these issues. The innovative design features spiral-cut tubes that increase the surface area by 18.2% compared to conventional cylindrical tubes, resulting in significantly improved heat transfer performance. To prevent corrosion, Titanium (Ti) has been selected for the tubes due to its superior resistance to seawater corrosion, while Duplex Stainless Steel is utilized for the shell and its components, providing enhanced mechanical strength and corrosion resistance. These materials, combined with the improved surface area, ensure higher heat transfer and extended operational life. The project involves the calculation of key design parameters and thermal properties to optimize performance. This is followed by the development of a 3D model to validate the structural and functional aspects of the design. Thermal analysis in SolidWorks revealed a uniform temperature gradient along the length of the heat exchanger tubes, demonstrating the effectiveness of the spiral cuts in promoting better heat transfer and minimizing hotspots. By addressing common issues in the CCW system, this heat exchanger design offers a reliable and efficient solution for industrial cooling applications.

Keywords: Shell and tube heat exchanger, Corrosion resistance, Efficiency, Seawater, Spiral cut

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Designing a privacy-driven question & answering system: Leveraging LLMs to handle complex document structures

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Many institutions handle large volumes of confidential information according to governance protocols. To extract knowledge from extensive document sources, it is essential to implement automated querying mechanisms or Question and Answering (QA) systems tailored to an organization's rules. However, many organizations struggle to utilize existing tools due to economic constraints, maintainability issues, and confidentiality concerns. Current QA systems often face challenges in processing large documents, leading to inefficiencies and inaccuracies. Furthermore, domain-specific keyword searching methods can be costly and compromise confidentiality when using available Large Language Model (LLM) APIs. This study aims to develop a systematic methodology to address these challenges. The literature review reveals that using unstructured documents directly yields low accuracy in knowledge extraction. This research proposes a systemic approach of converting unstructured data into semi-structured formats before further processing. This involves techniques such as chunking, tokenization, text embedding, and vector storage, followed by similarity searching to identify optimal data chunks, which are then analyzed using the GPT-3.5 Turbo model for precise answers. The materials employed include the GPT-3.5 Turbo API, LangChain framework, Python libraries, React, and FastAPI and MongoDB for managing backend database. The proposed approach significantly improves accuracy compared to existing methods in private domains. Finally, it was concluded that converting unstructured data into structured data through a semi-structured format (such as HTML or XML for text and OCR or image description models for non-text elements) would provide more accurate results compared to the existing context.

Keywords: LLM, Automated Querying, Knowledge Extraction, Confidentiality, AI technology, Unstructured Data
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Design of an automatic soil compactor for preparation of AASHTO T-180 D proctor specimens

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This research focuses on the design and development of an automated soil compactor for the AASHTO T-180 D Proctor compaction test, a critical procedure for determining optimum soil moisture content (OMC) and maximum dry density (MDD) in geotechnical engineering. Existing manual methods are labor-intensive, time-consuming, and present health hazards to technicians. Although existing automated systems address some issues, they lack compatibility with the AASHTO T-180 D standard, widely used in Sri Lanka. The proposed new design offers a safe, accurate, and effective device as a solution to the problems of manual processes and existing automated systems. The machine incorporates a chain-driven rammer lifting mechanism, a ratchet-based mold rotation system, and a car jack mold lifting mechanism to achieve precise soil compaction. The design includes automated control systems for monitoring and regulating rammer blows and mold rotation. Detailed simulations confirm that the stress and displacement experienced by the rammer are within acceptable limits, ensuring durability. The system reliably delivers uniform compaction through controlled rotation and consistent impact forces. The system provides uniform compaction through controlled rotation and consistent impact forces, advancing soil testing practices in the construction industry.

Keywords: Soil compaction, AASHTO T-180 D, Automated system

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Design and development of a ball screw scissor lift for efficient airport baggage handling

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Traditional baggage handling systems face inefficiencies and accessibility issues, particularly for differently-abled and elderly passengers. This research addresses these challenges by designing a ball screw scissor lift mechanism that enhances precision and operational efficiency in automated baggage handling. This study aims to develop and test a scissor lift driven by a ball screw mechanism to handle airport baggage more efficiently while minimizing maintenance costs and enhancing precision. The proposed system integrates a ball screw mechanism, driven by a servo motor, to provide precise control, smooth movement, and consistent load handling for up to 80 kg. With the use of 360-degree rotating balls mounted on the table surface, the design ensures smooth movements of baggage. The ball screw's low friction and minimal backlash characteristics offer significant advantages over traditional hydraulic and belt-driven systems. Further, it has a quality of precision controlling and minimum maintenance requirements. The anticipated performance of the system indicates its potential to deliver high levels of accuracy and operational smoothness, positioning it as a reliable solution for modern airports looking for optimizing the baggage handling processes. The study highlights the potential of incorporating automated lifting mechanisms to improve efficiency and reliability in airport logistics.

Keywords: Airport Baggage Handling, Automated Lifting System, Ball Screw Scissor Lift, Precision Control, High Efficiency

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Design of a tubular heat exchanger as a replacement for plate heat exchanger to reduce maintenance cost

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This study focuses on the design of a shell and tube heat exchangers that can effectively replace the plate heat exchangers in the Clean-In-Place (CIP) process of dairy manufacturing plants. One common problem associated with plate heat exchangers is the deformation and rupture of gaskets during nitric acid cleaning at high temperatures which results in costly repairs and many production downtimes. The proposed shell and tube heat exchanger solves these problems by eliminating use of rubber gaskets, and providing enhanced durability. The design features a shell and tube heat exchanger configuration made from Stainless Steel 304, which has good resistance to corrosion and high temperatures. Concept designs were assessed using a weighted decision matrix, while thermal performance was assessed through design calculations and computational fluid dynamics (CFD). By replacing the plate heat exchanger with a shell and tube heat exchanger, the project estimates a 25% reduction in maintenance costs, thereby contributing to increased operational efficiency in the dairy manufacturing plant. This cost-effective solution ensures long-term reliability in the CIP process. Future efforts will focus on prototype testing and further optimization.

Keywords: Clean-In-Place, Computational Fluid Dynamics, Plate Heat Exchanger, Tubular Heat Exchanger, Logarithmic Mean Temperature Difference

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Bearing fault identification using vibration analysis: A comparative study of theoretical and FFT-derived frequencies

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Bearings play a critical role and are essential components in rotating machinery. The purpose of this study is to classify the bearing faults by comparing the measured vibration frequencies with theoretical fault frequency values. An experimental set is developed to spin a given bearing at a constant angular speed and the vibration (acceleration) amplitudes are recorded at a constant sampling rate. Thus, the vibration frequency spectrum of a bearing is obtained using numerical Fast Fourier Transformation. There are different bearing faults, such as inner race faults, outer race faults, baller race faults, and cage faults. A theoretical model is used to classify bearing faults into the aforementioned types. The classification data, comprising vibration data categorized into four fault types, is utilized to develop a machine learning model for predicting bearing failures. This approach aids in early fault detection and can be implemented as a valuable component of predictive maintenance strategies.

Keywords: Bearing Fault Detection, Fast Fourier Transform (FFT), Predictive Maintenance, Vibration Analysis

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Automated PCB fault detection and component identification using image processing and machine learning

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Printed circuit boards (PCB) are widely applied in various fields to provide compact size and offer benefits in terms of weight and space efficiency in electronic devices. However, inspecting PCBs is unpleasant, with a variety of challenges due to complex layouts. Traditional inspection of a PCB relies highly on labour contributions and is time-consuming. This project proposes an automated analyzer using real-time image processing on YOLOv8, coupled with RoboFlow component labelling functionality, for the automatic identification of components and faults in PCBs, such as missing components. The analyzer recognizes various key components such as resistors, capacitors, diodes, Integrated Circuits (ICs) and relays, and their location. To ensure accuracy, the model was trained on a dataset of 1,000 images, achieving reliable identification results. The detection accuracy across 20 PCBs in three trials provides overall system accuracy at 86%. The automated approach utilizes TB6600 motor drivers, NEMA 17 stepper motors, and an Arduino UNO to control movement along the X, Y, and Z axes. A web camera is mounted on a system that can locate components, zoom in for a good view, and assist in removing components. This helps reduce material waste and production time while improving quality. Additionally, camera calibration was performed to ensure precise positioning of the components, making the inspection process both accurate and efficient. This system will be of great use for small-scale manufacturers, providing an economical way to thoroughly test and maintain PCBs without the use of specialized equipment.

Keywords: PCB, Faults, Image processing, YOLOv8, Automation

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Exploring project methodologies for Software Quality Assurance practices in Sri Lankan software industry

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Software quality assurance (SQA) practices play a significant role in delivering high quality products by systematically monitoring and evaluating the entire software development life cycle. Sri Lanka's emerging software industry should focus on the proper SQA practices. Unfortunately, a large number of companies fail to achieve their project objectives due to poor SQA practices. In this context, the study aims to identify SQA practices in Waterfall and Agile IS projects of BOI-registered firms in Sri Lanka. The study identifies three key factors: *project, stakeholder* and *company culture* while adopting a positivist philosophy, a deductive approach and a mono-method quantitative research strategy. An online survey was conducted among a sample of 63 BOI-registered software companies in Sri Lanka, selected using Morgan's sample size calculation method from a target population of 75. The data were analyzed using SPSS, employing descriptive and inferential statistical methods, including linear regression analysis. The study highlights strong positive correlations between the identified key factors and SQA practices, with correlations of 0.936, 0.927, and 0.908 for "Project," "Stakeholder," and "Company culture," respectively, in Waterfall IS projects, and 0.904, 0.859, and 0.542 in Agile IS projects. Linear regression analyses indicated that these independent variables accounted for 87.6%, 85.9%, and 82.4% of SQA practices in Waterfall IS projects, and 81.8%, 73.8%, and 29.4% in Agile IS projects, with all models significant (P-value < 0.05). The study extends on existing literature by highlighting key factors in identifying SQA practices, addressing challenges, and providing recommendations.

Keywords: Software Quality Assurance (SQA) practices, Waterfall, Agile, IS projects, BOI

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