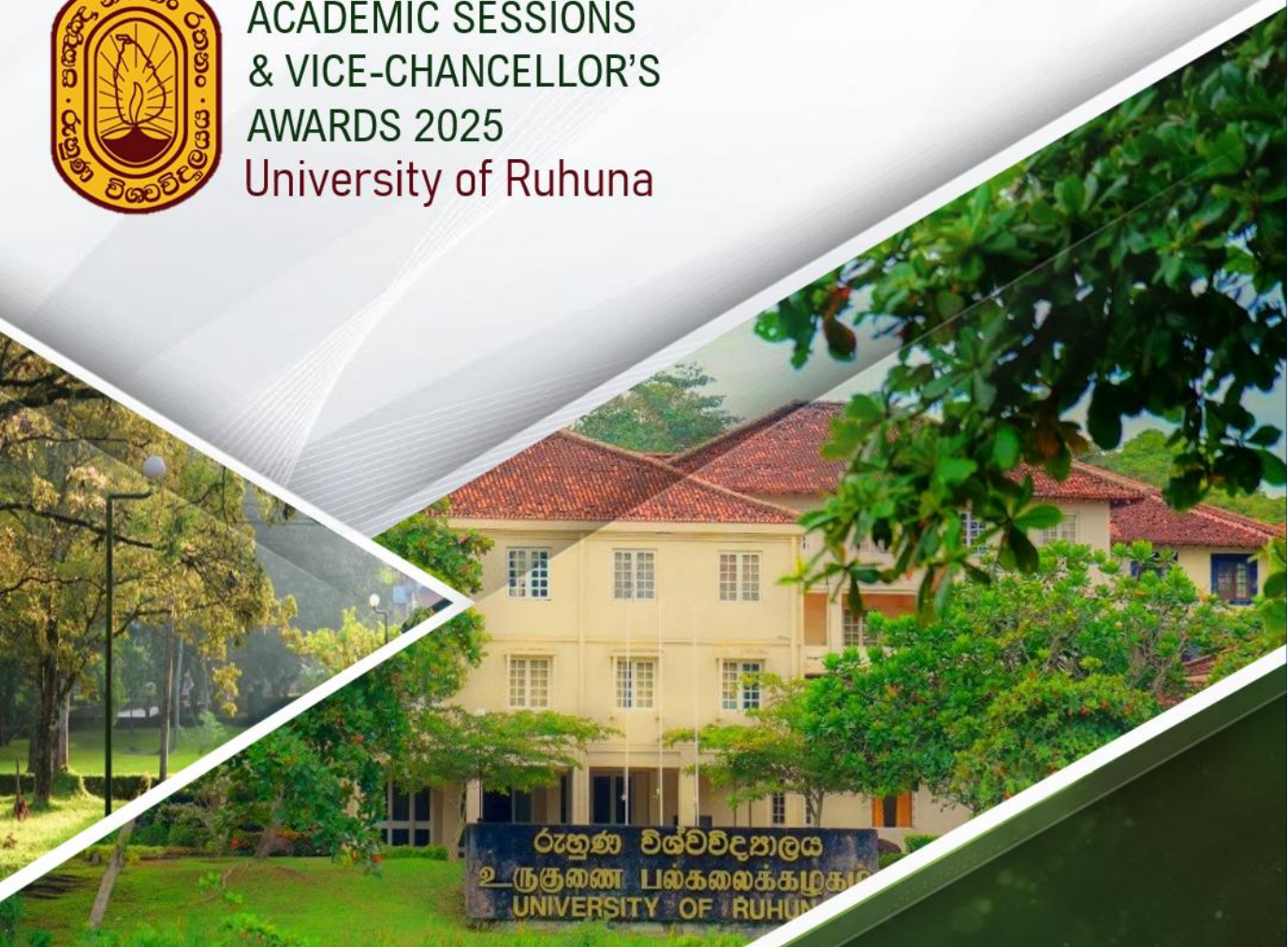
ACADEMIC SESSIONS & VICE-CHANCELLOR'S AWARDS 2025

University of Ruhuna



Innovating Across Boundaries: Bridging Knowledge for Global Impact

Proceedings

Sessions

- Agriculture, Environment and Biological Sciences
- Computer Science and Information Technology
- Economics, Finance and Management
- Education, Humanities and Social Sciences
- Engineering, Technology and Applied Sciences
- Human Health, Pharmaceuticals and Medicine
- Pure Sciences, Mathematics and Statistics

4th June 2025

Hosted by Faculty of Agriculture, University of Ruhuna

Academic Sessions and Vice Chancellor's Awards – 2025

04th June 2025

"Innovating Across Boundaries: Bridging Knowledge for Global Impact"

PROCEEDINGS

Hosted by
Faculty of Agriculture
University of Ruhuna
Sri Lanka

Proceedings of the Academic Sessions and Vice Chancellor's Awards - 2025

The Organizing Committee of Academic Sessions and Vice Chancellor's Awards – 2025

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Message from the Chairperson

It gives me great pleasure to welcome you to the Academic Sessions and Vice Chancellor's awards- 2025. Our theme this year, *"Innovating Across Boundaries: Bridging Knowledge for Global Impact."* encourages us to break down the barriers that limit innovation, disciplinary silos, institutional constraints, geographic divides and to instead foster a culture of openness, integration, and shared learning. Whether we are addressing issues of climate resilience, public health, digital transformation, or social equity, one truth stands clear: that is, innovation does not thrive in isolation. It thrives at the crossroads of diverse perspectives, cultures, and disciplines.

The Academic Session, an annual event of the University of Ruhuna, has become more than just an academic gathering; it is a celebration of the intellect, curiosity, and creativity that define the academic spirit of the University. This session brings together scholars and students from different faculties of the University each bringing their own unique lens to common challenges. It is this diversity of thought and experience that makes this forum rich, dynamic, and essential in the world today. In conjunction, the Vice Chancellor's Awards serve as a moving tribute to those who embody the highest levels of dedication, innovation, and impact in their disciplines. These awards reflect the unwavering dedication to developing talent, instilling intellectual curiosity, and cultivating an excellence culture that transcends boundaries and inspires future generations in University of Ruhuna.

I extend my sincere appreciation to our Chief Guest and Vice Chancellor of the University of Ruhuna, Senior Professor P.A. Jayantha for his valued leadership and unwavering support in organizing this prestigious event. Our remarkable keynote speaker, Senior Professor Rangika Halwatura, Faculty of Engineering, University of Moratuwa, deserves special recognition for his insightful remarks, which have expanded our logical thinking. I take this opportunity to thank former Dean of the Faculty of Agriculture, Senior Professor Sudas. D. Wanniarachchi for his confidence in my abilities and devotion enabled me to serve as the Chairperson of this important event and shoulder this enormous responsibility. The true leadership given by the present Dean of the Faculty of Agriculture, Senior Professor G.Y. Jayasinghe in organizing this event is greatly appreciated.

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I wish to congratulate the awardees of Vice-Chancellor's awards, University of Ruhuna Tier 4* award and best presenters of the previous year academic Session in 2024. Your remarkable accomplishments continue to inspire and motivate us to strive for higher levels of excellence and innovation. Let us also honor the distinguished scholars granted the title of Professor Emeritus, whose lasting contributions have profoundly shaped and enriched our academic community. I offer my heartfelt congratulation to the orator of the Academic Sessions and Vice Chancellor's awards- 2025.

A special note of appreciation goes to reviewers of the Academic Sessions. Your rigorous evaluation and profound insights have been critical in ensuring the integrity and quality of our academic discussions. The service rendered by the members of the editorial board lead by the editor-in-chief are highly acknowledged.

I am particularly proud to note the contributions of our emerging scholars, students, and early-career researchers whose bold ideas and fresh perspectives remind us that the future of innovation lies in nurturing the next generation of thinkers and changemakers. To all presenters and participants: may this platform inspire you, challenge you, and connect you with others who share your passion for knowledge and impact. May the conversations sparked here today echo far beyond this event, influencing classrooms, communities, and policies across the globe. I take this occasion to thank all the chairpersons and members of the technical session assessment committees for their commitment to render impartial judgment. Let me also take this opportunity to express my sincere gratitude to the faculty coordinators, members of the organizing committee, administrative and support staff who have worked tirelessly to make this session a reality.

In closing, let us remember knowledge becomes power not when it is contained, but when it is shared. Innovation becomes meaningful not when it is measured only in novelty, but when it improves lives. And boundaries academic, cultural, or otherwise are not lines that divide us, but bridges waiting to be built.

Thank you, and I wish you all a productive and inspiring session ahead.

Prof. Menaka Fernando
Chairperson/ Academic Sessions and Vice Chancellor's Awards 2025
University of Ruhuna

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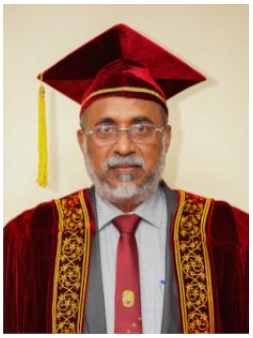
Message from the Vice Chancellor



It is with immense pleasure that I extend my warmest greetings to all participants of the Academic Sessions and Vice Chancellor's Awards ceremony in 2025 of the University of Ruhuna. This annual event serves as a vital platform for showcasing the research accomplishments of our academic staff and students, highlighting our strong commitment to excellence, innovation, and societal advancement.

The theme of the academic sessions for this year, "Innovating Across Boundaries: Bridging Knowledge for Global Impact," emphasizes the importance of international knowledge exchange and interdisciplinary collaboration. It challenges us to think beyond traditional academic practices, embrace collaborations beyond academia, and cultivate an approach that values adaptability, diversity, and global significance. In this context, the barriers that traditionally separated different disciplines, institutions, and nations are now more open and interconnected than ever.

The University of Ruhuna remains committed to fostering a dynamic research culture. We actively encourage interdisciplinary collaboration to tackle challenging societal and global issues. By promoting inclusive academic practices, we ensure that all members of our community can contribute meaningfully to innovation. Strategic partnerships with local and international universities further enhance the impact and reach of our research. Through these initiatives, we empower our researchers and students to create solutions that are both locally and globally significant.

I extend my heartfelt appreciation to all participants, organizers, and supporters of the Academic Sessions 2025. Let us embrace this opportunity to spark new ideas and reaffirm our role as changemakers. We witness that we can steer towards a more resilient future by working together.

Senior Prof. P. A. Jayantha
Vice Chancellor
University of Ruhuna

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Award of Emeritus Professorships

Senior Professor P.L.A.G. Alwis

Faculty of Agriculture

Senior Professor Mangala De Zoysa

Faculty of Agriculture

Senior Professor Sarath Lekamwasam

Faculty of Medicine

Recipients of the Vice Chancellor's Awards - 2024

The Most Outstanding Scholar

Prof. Disna Ratnasekera

Faculty of Agriculture

The Most Outstanding Young Researcher

Dr. Dushan Kumarathunga

Faculty of Agriculture

Recipients of the UOR Tier 4 Star Award

Prof. G.H.M.J. Subashi De Silva

Faculty of Engineering

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Recipients of the Best Presenter Awards
Academic Sessions 2024
Technical Sessions (Oral)

Agriculture, Environment and Biological Sciences

Dr. L.N. Wijewardene

Department of Limnology and Water Technology
Faculty of Fisheries and Marine Sciences & Technology

Education, Humanities and Social Sciences

Prof. H.I.G.C. Kumara

Department of Geography
Faculty of Humanities and Social Sciences

Human Health, Pharmaceuticals and Medicine

Mrs. W.N.D. De Silva

Department of Biochemistry
Faculty of Medicine

Economics, Finance and Management

Mrs. B.B.D.S. Abeykoon

Department of Marketing
Faculty of Management and Finance

Engineering, Technology and Applied Sciences

Mr. P.H.T. Maduranga

Faculty of Engineering

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Recipients of the Best Presenter Awards
Academic Sessions 2024
Technical Sessions (Poster)

Poster Session 1

Mr. H.M.P. Bandara

Faculty of Engineering

Poster Session 2

Mr. H.M.S. Sanjaya

Faculty of Engineering

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Keynote Speech
Past Forward: A Cross-disciplinary Road to Sustainability

True sustainability doesn't belong to one discipline it emerges at the intersection of many. This keynote explores how a cross-disciplinary approach, grounded in both tradition and innovation, can lead us toward more resilient, community-centered solutions.

We begin by revisiting time-tested technologies in construction, agriculture, and medicine developed by ancient civilizations in harmony with nature. By comparing these with modern systems, we expose where current practices have strayed from ecological wisdom and where old paths offer new insights. This sets the stage to distinguish between invention and innovation between creating something new and embedding it meaningfully into the world.

Drawing from my own work, I will present several nature-inspired inventions, including soil-based construction systems such as mud concrete blocks. These innovations sit at the crossroads of engineering, design, environmental science, and cultural heritage. We'll also explore how decoding ancient practices has led to fresh ideas for low-carbon, climate-adaptive technologies.

But sustainability doesn't happen in the lab alone. The final section focuses on how to bring these innovations to life in communities making them accessible, adaptable, and truly transformative. This is where cross-disciplinary collaboration becomes essential, blending science with empathy, and research with relevance.

This keynote invites you to move past forward to reimagine the future by learning from the past, and to explore sustainability as a shared journey across disciplines, cultures, and time.

Prof. R.U. Halwathura
Department of Civil Engineering
Faculty of Engineering
University of Moratuwa

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Invited Oration
Pharma-nature Fusion: Integrated Approaches for Effective Pain Control and Relief

Dr. P.W.D. Wasana

Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna

Abstract:

Pain management poses a significant healthcare challenge, prompting exploration into innovative strategies. Our work embodies a fusion of pharmaceutical and natural approaches to enhance pain relief using curcumin, a natural polyphenolic compound. Through synergistic drug combinations (curcumin-metformin and curcumin-piperine), nanoformulations (curcumin-metformin-coloaded chitosan/alginate nanoparticles), and prodrug development (curcumin diglutaric acid, curcumin diethyl diglutarate, and curcumin diethyl γ-aminobutyrate), we aimed to fortify curcumin's efficacy against diverse pain types. Findings demonstrated enhanced analgesic effects, improved pharmacokinetic profiles, and promising safety profiles, laying the foundation for advanced pain management solutions integrating pharmaceutical and natural elements.

Keywords: *Alginate, Chitosan, Curcumin, Pain, Piperine, Prodrugs, Metformin, Nanoparticles*

Background

Pain is a response of nociceptors to either noxious or non-noxious stimuli, which triggers the central nervous system to experience it. Though pain serves a protective function, the excessive triggering of nociceptors leads to a devasting condition identified as nociceptive pain. If left untreated, acute pain can evolve into a chronic state, emphasizing the significance of effective pain management. Moreover, the widespread prevalence and substantial impact of pain on physical, social, and emotional well-being highlight its critical importance in healthcare (Yong et al., 2022). Current pain management methods, encompassing non-opioid analgesics (nonsteroidal anti-inflammatory drugs, local anesthetics, and steroids), opioids, and adjuvant analgesics (anticonvulsants and antidepressants), face limitations such as reduced efficacy

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and associated side effects. This drives the exploration of alternative strategies in pain management, leading to increased interest in natural bioactive compounds like curcumin (Cur). Its diverse pharmacological activities and superior safety profile have drawn significant attention in this pursuit (Dasuni Wasana et al., 2022).

Curcumin, derived from *Curcuma longa* (turmeric), is a natural polyphenolic compound renowned for its pleiotropic properties, such as anti-inflammatory, antioxidant, and potential anticancer effects. Its extensive historical use in Asian traditional medicine speaks to its safety, considered 'generally recognized as safe' by the US FDA (US FDA, 2011), with minimal short- and long-term toxicity. Studies in animals and humans have highlighted its therapeutic potential in various pain conditions, including nociceptive, inflammatory, and neuropathic pain (Sun et al., 2018). Considering the mechanism of action, curcumin acts through various mechanisms, modulating pain-related neurotransmitters, suppressing immune responses, blocking TRPV1 receptors, and affecting chemokine receptors, effectively providing pain relief. Nonetheless, it faces challenges due to its low stability, poor water solubility, and rapid breakdown in the gastrointestinal tract and liver, despite its evident advantages (Hasriadi et al., 2021). As a result, ongoing research endeavors are actively exploring diverse strategies aimed at boosting curcumin's therapeutic effectiveness.

Our research aims to assess diverse strategies to enhance the bioavailability of curcumin, encompassing approaches such as drug combinations, chemical modifications, and nanoformulations. Evaluations were conducted to explore the synergistic analgesic potential of curcumin when combined with other compounds, such as metformin (Dasuni Wasana et al., 2022), and piperine (Boonrueng et al., 2022). Furthermore, these findings guided the development of curcumin and metformin-loaded chitosan-alginate nanoparticles, enabling the co-delivery of both agents within a single formulation (Wasana et al., 2023). Exploring the chemical modification approach, our investigation involved the conjugation of curcumin with various entities to enhance its physicochemical profile, hindering gastrointestinal degradation and rapid metabolism. Analgesic assessments were conducted with several curcumin prodrugs: curcumin diethyl γ-aminobutyrate (Hasriadi et al., 2022), curcumin diethyl diglutarate (Limcharoen et al., 2021), and curcumin diglutaric acid (Limcharoen et al., 2020). Through these multifaceted

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methodologies, we substantiated the heightened therapeutic efficacy of curcumin across various mouse models of pain.

Aims and Objectives

General Objective

To enhance the therapeutic potential of curcumin in pain management by evaluating strategies that improve its bioavailability and analgesic efficacy.

Specific Objectives

1. To investigate the synergistic analgesic effects of curcumin when combined with other compounds such as metformin and piperine.
2. To develop and characterize curcumin–metformin co-loaded chitosan-alginate nanoformulations for improved co-delivery, sustained release, and enhanced analgesic effects.
3. To assess the physicochemical and analgesic properties of chemically modified curcumin prodrugs aimed at improving its stability, bioavailability, and therapeutic efficacy.
4. To evaluate the central nervous system safety of curcumin in its combined, nanoformulated, and chemically modified (prodrug) forms.

Materials and Methods

Animals

Male ICR mice (4–8 weeks old) were obtained from Nomura Siam International Co., Ltd. (Bangkok, Thailand) and housed (4–5 per cage) under controlled conditions (22 ± 2 °C, 40–60% humidity, 12:12 h light/dark cycle) with free access to food and water at the Laboratory Animal Research Facility, Faculty of Pharmaceutical Sciences, Chulalongkorn University. Mice were acclimatized for at least one week before experiments. Ethical approval was granted by the Institutional Animal Care and Use Committee, Faculty of Pharmaceutical Sciences, Chulalongkorn University, Bangkok, Thailand, before the commencement of the study.

Drugs and Treatments

Curcumin (>95.0 %) and piperine (97%) were purchased from Shaanxi Kanglai Ecology Agriculture Co., Ltd. (Xi'an, China), and Sigma, St. Louis (MO, USA), respoectively. Met was provided by the Siam Bheasach Co. Ltd. (Bangkok, Thailand).

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Statistical Analysis

The data analysis was performed using GraphPad Prism 9.1 (GraphPad Software Inc., La Jolla, CA, USA). All the collected data were summarized with counts percentage for categorical variables. The numerical values were presented as mean ± SD for *in vitro* data and nanoparticle properties and mean ± SEM for animal data (8-10 mice per group). The difference between groups was determined by the One-way analysis of variance (ANOVA) followed by the *post hoc* test. Statistical significance was considered when the *p*-value is < 0.05 (95% confidence level).

1. Curcumin and other drug combination approach for synergistic analgesia

In recent years, research has highlighted the advantages of combining drugs in pain management, showcasing higher efficacy, and reduced adverse effects compared to single-drug approaches. This could be attributed to their capacity to target multiple sites along the pain pathway, thereby minimizing the required doses of each compound in the combination. Based on this understanding, our focus has been on assessing the potential synergistic effects between curcumin and various other compounds possessing analgesic properties.

1.1. Synergistic interaction: curcumin and metformin

This study assessed whether curcumin could synergistically interact with metformin, potentially reducing the required doses of both compounds. Initial in vitro experiments using lipopolysaccharide-induced RAW 264.7 macrophage and BV-2 microglia cells demonstrated that curcumin amplified the anti-inflammatory effects of metformin. The metformin-curcumin combination notably suppressed LPS-induced inflammatory mediators (nitric oxide, TNF-α, and IL-6) more effectively than individual components, indicating potential synergy in peripheral and central pain pathways. This interaction was further explored in a mouse model of formalin-induced pain. Mice received oral doses of curcumin, metformin (3, 10, 30, 100, and 300 mg/kg), or a fixed 1:1 ED_{50} ratio combination, one-hour post-formalin administration, and hind paw licking behavior was observed for 40 minutes. The doses achieving 50% antinociception (ED_{50}) were established at 82.8 ± 17.6 mg/kg for curcumin and 248.9 ± 106.5 mg/kg for metformin using a linear-logarithmic dose-response model. Co-administration of curcumin and metformin at their 1:1 ED_{50} ratio significantly reduced the dose required for a

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50% effect in phase II of the formalin test (39.6 ± 7.1 mg/kg), supported by a combination index value of 0.24 (**Table 1**). Crucially, this synergistic interaction did not induce severe CNS side effects, as evidenced by the absence of motor alterations in rotarod tests, short-term and long-term locomotion changes, and overall well-being evaluated through LABORAS automated home cage monitoring. These findings collectively suggest that curcumin may enhance the anti-inflammatory effects of metformin synergistically without adverse effects on the CNS (Dasuni Wasana et al., 2022).

Table 1. The summary of curcumin interaction with metformin in mouse model of formalin-induced pain-like behaviors.

Combination	**ED_{50} Theoretical (Additive)**	**ED_{50} Experimental**	**CI**	**Interaction**
Curcumin-Metformin	165.8 ± 62.0	39.6 ± 7.1***	0.24	Synergistic

CI = Combination Index; = 1, additive; < 1, synergistic; > 1, antagonistic.
*** represents statistical significance between ED_{50} theoretical and ED_{50} experimental by t-test ($p < 0.001$)

1.2. Synergistic interaction: curcumin and piperine

Similar to the previous study, our group evaluated the synergism between curcumin and piperine in pain attenuation. Curcumin and piperine, prominent bioactive compounds in *Curcuma longa* and *Piper nigrum*, are commonly used together in Southeast Asia. The combination was assessed in animal models for chemical-induced pain, thermal hyperalgesia, and cold allodynia using isobolographic analysis. Curcumin alone demonstrated dose-dependent improvements in pain-like behaviors, with ED_{50} values of 71.4, 34.4, and 31.9 mg/kg in formalin, tail-flick, and cold plate tests. Piperine also exhibited efficacy with ED_{50} values of 18.4, 8.1, and 28.1 mg/kg, respectively. The combination significantly reduced the dose required for 50% antinociception (5.9, 5.2, and 5.5 mg/kg) compared to predicted additive ED_{50} doses (44.9, 21.3, and 30.0 mg/kg) in formalin, tail-flick, and cold plate tests. The combination index values were 0.13, 0.24, and 0.18, indicating strong synergism **(Table 2).** LABORAS automated home-cage analysis revealed reduced locomotive behaviors with piperine (100 mg/kg) alone, but the combination had no impact on spontaneous locomotion. In conclusion, the findings show curcumin and piperine synergistically inhibit pain in mice

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models with no significant CNS side effects, suggesting its application to clinical trials (Boonrueng et al., 2022).

Table 2. The summary of curcumin interaction with piperine in mouse models of pain

Animal Model	ED_{50} Theoretical (Additive)	ED_{50} Experimental	CI	Interaction
Formalin model	44.9 ± 12.5	5.9 ± 2.2***	0.13	Synergistic
Tail-flick	21.3 ± 3.4	5.2 ± 0.6***	0.24	Synergistic
Cold plate	30.0 ± 5.9	5.5 ± 0.7***	0.18	Synergistic

CI = Combination Index; = 1, additive; < 1, synergistic; > 1, antagonistic.
*** represents statistical significance between ED_{50} theoretical and ED_{50} experimental by t-test ($p < 0.001$)

Overall, these results support the possibility of combined use of curcumin with other compounds: metformin and piperine in the treatment of pain with the least amount of medication while taking the easiness of administration, cost of the therapy, and side effect profile of medicines into the account.

2. Curcumin nanoparticle approach for improved therapeutic efficacy against pain.

Nanotechnology plays a pivotal role in multimodal analgesia by providing an exceptional opportunity to finely tune drug loading and co-delivery of therapeutic agents to target sites, thereby enhancing the therapeutic efficacy and safety of analgesic agents. Endogenously, CTS/ALG NPs contribute to enhancing the oral bioavailability of the payload through multiple mechanisms. Firstly, they enhance solubility, safeguarding therapeutic agents from gastrointestinal (GI) degradation, including acid hydrolysis and enzymatic breakdown. Additionally, these nanoparticles improve drug absorption through the GI epithelium, utilizing both transcellular and paracellular transport pathways. Moreover, CTS/ALG promotes mucoadhesion, thereby extending nanoparticle retention in the GI tract, a notable advantage. These natural polymers possess several other advantages, including cost-effectiveness, biocompatibility, biodegradability, and low toxicity. These qualities strongly advocate for the use of CTS/ALG as a nanocarrier for delivering the curcumin-metformin combination orally.

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Co-encapsulation of curcumin (Cur) and metformin (Met) into chitosan/alginate (CTS/ALG) nanoparticles (NPs) at synergistic drug ratios was achieved using response surface methodology (RSM). The optimized Cur-Met-CTS/ALG-NPs were achieved with Pluronic® F-127 2.33% (w/v), Met 5.91 mg, and CTS/ALG mass ratio 0.05:1. The prepared Cur-Met-CTS/ALG-NPs exhibited a particle size of 243 ± 13 nm, a zeta potential of -21.6 ± 0.9 mV, and encapsulations of Cur at 44.2 ± 1.4% and Met at 32.6 ± 0.4%. The loading of Cur and Met was 6.8 ± 0.5% and 19.6 ± 0.9%, respectively, with a Cur/Met mass ratio of 1:2.9.

Polymeric nanoparticles (NPs) are susceptible to instability caused by biochemical attack and swelling. Hence, extensive studies on long-term colloidal stability were conducted to assess their durability during storage. The optimized Cur-Met-CTS/ALG-NPs, stored at 4°C, displayed superior stability compared to those stored at 25°C, where aggregation occurred within two months. Furthermore, their resistance to enzymatic degradation in simulated gastrointestinal (GI) fluids was investigated. The Cur-Met-CTS/ALG-NPs exhibited enhanced stability against enzymatic degradation in these conditions (**Table 4**), highlighting their potential as a dependable carrier for oral Cur and Met delivery.

Table 4. Stability of Met-Cur-CTS/ALG-NPs under simulated GI conditions

GI condition	Size (nm)	Zeta potential (mV)
Original	243 ± 13	-21.6 ± 0.9
Mouth phase	235 ± 24	-14.8 ± 2.5***
Stomach phase	640 ± 34***	-2.8 ± 0.3***
Small intestine phase	256 ± 29	-8.0 ± 0.6***

***$p < 0.001$ compared to the particle size and zeta potential before digestion (student's t-test)

The release pattern of Cur and Met from Cur-Met-CTS/ALG-NPs under various pH conditions (simulating gastric, intestinal, and body fluids) was examined using the dialysis bag method. These NPs demonstrated an initial burst release followed by sustained release across all pH levels. Additionally, the Cur-Met-CTS/ALG-NPs exhibited increased mucoadhesion, supporting their suitability as an oral drug delivery system. Enhanced mucoadhesion prolongs NP retention in the GI tract, elevating local drug concentration and

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subsequent oral bioavailability. Finally, the cellular uptake of Cur in its free and nano forms was assessed using epithelial cells. Caco-2 cells treated with Cur-Met-CTS/ALG-NPs displayed intensified cytoplasmic green fluorescence surrounding the nuclei compared to cells treated with free Cur. This observation suggests a higher cellular internalization of Cur when utilizing NPs, indicating their potential effectiveness.

Furthermore, the efficacy of Cur-Met-CTS/ALG-NPs was evaluated in mice. The animals were treated with ED_{50} dose of a Met-Cur physical mixture (40 mg/kg; 10 mg/kg Cur + 30 mg/kg Met), an equivalent dose of Met-Cur-NPs, blank NPs, or the vehicle. One hour after treatment administration, the mice received an intraplantar injection of formalin (5%, 10 µL), and pain-like behaviors were assessed by measuring hind paw licking responses. Orally administered Cur-Met-CTS/ALG-NPs resulted in significantly greater attenuation of phase II pain-like behaviors (68 ± 3 % inhibition of hind paw licking) compared to the vehilce control group (50 ± 2 %). Similarly, the release of proinflammatory cytokines in paw tissues was significantly reduced in the Cur-Met-CTS/ALG-NP group compared to the group treated with the Met-Cur physical mixture. Additionally, a central nervous system safety pharmacology study in mice revealed no potential CNS side effects associated with Cur-Met-CTS/ALG-NPs as mice treated with the NPs showed comparable locomotive behaviors (climbing, rearing, locomotion, and immobility), distance travelled, and speed to those of the control mice.

In conclusion, these findings lay the groundwork for a nano delivery system for Cur-Met combination therapy against pain, promising improved efficacy and safety. However, future studies are required to evaluate the safety of higher doses or chronic administration to better understand their potential benefits and limitations in clinical applications (Wasana et al., 2023).

3. Chemical modification of curcumin for improved therapeutic efficacy against pain.

A prodrug is an inactive form of the parental drug that undergoes biotransformation into an active form upon administration to the body, aiming to enhance the performance of the parent drug. This approach is employed to improve various properties of the parent drug, including its physicochemical and pharmacokinetic attributes. Recently, several prodrugs exhibiting excellent anti-inflammatory enhancement and superior safety profiles compared to their parent drugs have been reported. Among these are commercially available

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medications like sulindac, parecoxib, nabumetone, and nepafenac (Phumsuay et al., 2020). Therefore, we applied this approach to curcumin, developing several curcumin conjugates. Among them, the therapeutic efficacy of its ester prodrugs: curcumin diglutaric acid (CurDG) and curcumin diethyl diglutarate (CurDDG), and the amino acid prodrug: curcumin diethyl γ-aminobutyrate (CUR-2GE) were evaluated for their effectiveness against pain, comparing them with pure curcumin.

CurDG represents a novel prodrug known for significantly increasing water solubility and promptly converting to curcumin in human plasma. Additionally, the ester prodrug CurDDG demonstrates the capability to bypass curcumin's phase II metabolism through glucuronidation and sulfation pathways. Consequently, our studies aimed to assess the analgesic potential of both prodrugs using a mouse model of chronic constriction-induced neuropathic pain. Mice received various oral doses of curcumin (25, 50, 100, and 200 mg/kg/day) or equimolar doses of CurDG and CurDDG for 14 consecutive days. CurDG and CurDDG, at all doses administered, significantly alleviated CCI-induced thermal hyperalgesia and mechanical allodynia compared to the CCI-control group. Furthermore, both CurDG and CurDDG demonstrated significantly superior efficacy in addressing both mechanical and thermal hypersensitivities compared to curcumin alone. Notably, the effect of CurDDG corresponded with the suppression of TNF-α and IL-6 levels in both the sciatic nerve and spinal cord, relative to their respective control groups. Overall, our findings illustrate the enhanced pharmacological effects of curcumin against neuropathic pain through its ester conjugates, CurDG (Limcharoen et al., 2020) and CurDDG (Limcharoen et al., 2021).

Other than the aforementioned prodrugs, CUR-2GE, a carbamate prodrug of curcumin, was developed to overcome limitations associated with curcumin. We investigated CUR-2GE and curcumin in mouse models induced by carrageenan and lipopolysaccharide (LPS). CUR-2GE outperformed curcumin, significantly improving hyperalgesia and locomotor activity in carrageenan-induced mice. It also suppressed peripheral inflammation indicated by reduced TNF-α and IL-6 levels. In LPS-induced mice, CUR-2GE demonstrated better control over sickness and pain-like behaviors compared to curcumin, significantly reducing proinflammatory cytokines in plasma and spinal cord tissue. Importantly, acute and chronic CUR-2GE administration did not affect motor coordination or locomotive behaviors, suggesting no potential

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CNS side effects. These findings highlight CUR-2GE's enhanced therapeutic efficacy against inflammatory pain (Hasriadi et al., 2022).

These comprehensive studies underscore the potential of prodrugs, particularly CurDG, CurDDG, and CUR-2GE, as promising candidates for improving curcumin's therapeutic efficacy against neuropathic and inflammatory pain conditions, offering enhanced treatment options with potentially fewer side effects.

Limitations

Despite promising outcomes, the studies on curcumin-based pain relief strategies face several limitations. Firstly, the findings are predominantly based on preclinical mouse models, which may not fully translate to human physiology. The bioavailability enhancement techniques, including drug combinations, nanoformulations, and prodrugs, though effective in controlled settings, require validation through human clinical trials to assess real-world applicability, long-term safety, and efficacy. Additionally, the chemical modifications and nanoparticle systems may pose challenges in large-scale manufacturing, stability, and regulatory approval. Moreover, pharmacokinetic interactions between curcumin and co-administered agents like metformin and piperine require deeper exploration to ensure no adverse metabolic effects. These limitations indicate the need for advanced pharmacological and clinical studies to bridge the gap from bench to bedside.

Conclusion

Curcumin has shown therapeutic efficacy against pain by targeting multiple mechanisms in the pain pathway; however, its poor pharmacokinetics and low oral bioavailability limit its clinical application. In response, our study delved into multiple pharmaceutical approaches aimed at enhancing curcumin's therapeutic potential for pain management. Our approaches included a drug combination strategy, a nanotechnology approach employing nanoparticles, and a prodrug approach. These innovative formulations, such as the curcumin-metformin and curcumin-piperine combinations, the Cur-Met-CTS/ALG-NPs nanoparticles, and the prodrugs (CurDG, CurDDG, and Cur-2GE), exhibit the potential for clinical trials. They hold promise as future analgesics with improved efficacy and safety profiles. The diverse strategies explored in this research lay the groundwork for advancing curcumin-based formulations into potential clinical applications for pain management.

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Effects of Litter Mass on Carbon dioxide Emissions and Organic Matter Content in Mahogany Forest Soils

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Abstract

Litter mass (LM) accumulation and subsequent decomposition affect soil organic matter (OM) content and atmospheric Carbon dioxide (CO_2-C) emissions, influencing climate change. Despite the abundance of Mahogany mixed forests in wet and intermediate climatic zones in Sri Lanka, there are no comprehensive studies on soil CO_2-C emissions and OM dynamics. This study aimed to assess the short-term impacts of LM on CO_2-C emissions and OM% in a tropical Mahogany forest soil (MFS) at the Faculty of Agriculture, University of Ruhuna, Sri Lanka. Three pits (1×0.5 m^2) were prepared at random sampling points and they were filled with grassland soil (GLS) to eliminate the effects of accumulated LM over time. Soil (0-10 cm depth) and LM sampling was done on nine days (1-2 weeks intervals) during March to August 2023. The CO_2-C emissions and OM% were determined by NaOH-trapping and chromic acid wet oxidation (Walkley and Black) methods, respectively. The correlation analysis was done using the Microsoft Excel 2010 data analysis tool pack. The results revealed that initial OM% of GLS increased from 1.87% to 2.21%, approaching that of the original MFS (2.6%), suggesting enhanced soil carbon (C) stock. The OM% increased with LM up to 0.4 kg m^{-2}, then declined, while CO_2-C emissions showed the opposite trend, initially decreasing and then increasing at the same LM. The LM of 0.4 kg m^{-2} was a critical value (CV), which affected CO_2-C emissions and OM% conversely. According to previous studies, the flavonoid compounds in Mahogany leaves inhibit microorganisms by forming complex compounds with microbial proteins. This can be a reason for the reduced CO_2-C emissions and increased OM% with increasing LM up to a level of CV. With the succession of LM exceeding the CV, Mahogany litter decomposers could enhance their population growth and fresh OM inputs possibly generated priming effects, causing a disproportionate increase in CO_2-C flux and net losses in soil C stock. Overall, the LM in a tropical MFS offered insights into the short-term OM dynamics, aiding assessments of forest floor contributions to climate change through CO_2-C emissions.

Keywords: *CO_2-C emissions, Critical value, Litter mass, Mahogany, Organic matter*

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TSS and TDS Removal from Batik Wastewater through Water Hyacinth Phytoremediation

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Abstract

Batik industries generally generate wastewater with extremely high levels of total suspended solids (TSS) and total dissolved solids (TDS), which are environmentally toxic. Conventional technologies for this are costly and beyond the reach of small-scale producers. The current study evaluated the performance of water hyacinth (*Eichhornia crassipes*) for the removal of TSS and TDS from batik wastewater. Three phytoremediation chambers containing 10 L of wastewater were treated with 5, 10, and 15 clumps of water hyacinth. Experimental setups included treated and filtered wastewater, treated and unfiltered wastewater, and control. Water quality parameters like pH, TSS, and TDS were measured on days 1, 7, 14, 21, and 28. Statistical analysis was done using ANOVA. The TDS values (mg/L) progressively showed a decrease across the study period. For the control, the reduction was from 1.92 to 0.8 (5 plants), 1.92 to 0.7 (10 plants), and 1.92 to 0.6 (15 plants). In treated and filtered wastewater, the reduction was from 1.76 to 0.72 (5 plants), 1.76 to 0.6 (10 plants), and 1.76 to 0.5 (15 plants). Values dropped from 2.37 to 1.45 (5 plants), 2.37 to 1.2 (10 plants), and 2.37 to 0.95 (15 plants) for treated and unfiltered wastewater, with larger reductions observed with an increase in plants. Statistical analysis confirmed that there was no significant difference between treatments and control with a p-value 0.073 ($p > 0.05$). This confirms there is no significant difference in TDS removal between groups. The control group's TSS values (mg/L) decreased from 0.0150 to 0.011 (5 plants), 0.0150 to 0.011 (10 plants), and 0.0150 to 0.01 (15 plants). The range of decreases in treated and filtered wastewater was 0.0327 to 0.0247 (15 plants), 0.0327 to 0.025 (10 plants), and 0.0327 to 0.03 (5 plants). TSS readings for treated and not-filtered wastewater dropped dramatically from 0.3653 to 0.1143 (5 plants), 0.3653 to 0.1017 (10 plants), and 0.3653 to 0.094 (15 plants). Statistical analysis confirmed significant differences ($p < 0.05$) between treatments and control, highlighting the effectiveness of the water hyacinth. TDS and TSS results were compared with central environmental authority discharge limits, which indicated that phytoremediation with water hyacinth improved wastewater quality within permissible limits. The current research illustrates the potential of water hyacinth as a low-cost and eco-friendly alternative for the treatment of wastewater in small-scale batik industries.

Keywords: *Batik wastewater, Phytoremediation, Total dissolved solids, Total suspended solids, Water hyacinth*
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Effect of Burial Depth on Seedling Emergence of *Mimosa pigra* L. Invaded Areas in Southern Province, Sri Lanka

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Abstract

Mimosa pigra L., belongs to the family Fabaceae, commonly known as the giant sensitive plant or giant mimosa, and is recognized as a significant invasive weed, that originated in the tropical American region, from Mexico to Argentina. *M. pigra* was first reported in Sri Lanka in 1997 and subsequently colonized the Central and North-western provinces, spreading into other regions, including the Southern province. *M. pigra* has invaded cultivable lands, including fallow paddy fields, and according to previous research, nearly 27 ha of land were invaded by *M. pigra* within the study area. This study aimed to evaluate the germination of *M. pigra* seedlings in different soil depths of the seed bank. Seed bank samples were collected from Akuressa divisional secretariat divisions and Paraduwa GN divisions in the Southern province of Sri Lanka, where the *M. pigra* invasion is significant. The experiment followed the randomized complete block design. Samples were collected from each quadrat using a 20 × 20 cm surface area frame to a depth of 30 cm, segmented into a 5 cm depth series. A total of 120 samples were obtained from 20 sampling points, including four control points. The depth intervals were designated as follows: A (0–5 cm), B (5–10 cm), C (10–15 cm), D (15–20 cm), E (20–25 cm), and F (25–30 cm). Seed bank samples were allowed to germinate, and the emergence of *M. pigra* and other vegetation types in different soil depths were counted by visual observation and recorded weekly up to eight weeks. The emergence of *M. pigra* declines with the soil depth and is abundant in shallower depths (0-5 and 5-10 cm). The Average emergence per 1×10^{-3} m^3 of *M. pigra* is as follows: A (1.55), B (0.8), C (0.15), D (0.2), E (0.33), and F (0.05). According to these results, the emergence declines with increasing depth. Therefore, it is recommended that land preparation in *M. pigra* invaded fields be conducted at a ploughing depth below 10 cm to reduce seed exposure and minimize subsequent seedling emergence.

Keywords: *Dispersal, Fabaceae, Germination, Invasion, River banks*

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Effectiveness of Immobilized Nirmali Seeds and Free Nirmali Seeds as a Bio Coaugulant in Removal of Turbidity of Water

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Abstract

Water treatement is an essensial process due to water scarcity. While previous studies have extensively explored raw and powdered forms of Nirmali seeds as a bio coagulant, this study introduces a novel approach by immobilizing Nirmali seed powder within calcium-alginate beads to assess its potential for turbidity removal. The natural surface water from the Kelani river was treated with bio coagulant with four treatments which are immobilized bio coagulant wet basis, immobilized bio coagulant dry basis, raw Nirmali seed powder and alum as the control treatment and range of doses from 0.5 g/L to 3 g/L. To determine the optimum dosage for turbidity removal and coagulation/flocculation efficiency the jar tester was conducted according to the standardized procedure. After treatment Alum has shown greatest efficiency in removal of turbidity of water while immobilized bio-coagulants (wet and dry basis) showed very low turbidity reduction, at all doses. The high increase in turbidity is also observed after being treated with raw Nirmali seed powder. The reasons for the limited effectiveness of the immobilized bio coagulants is likely due to the slow release of bioactive compounds into water, the reduced availability of active binding sites due to encapsulation, and the physical form of the seeds potentially influencing interaction with colloidal particles. These findings suggest that while the immobilization technique offers a novel and potentially eco-friendly delivery method, it may hinder the coagulation efficacy of Nirmali seeds in turbidity removal applications. The values of electrical conductivity were highly increased in water which treated with alum while other treatment showed no significant increase. The results of the present study clearly demonstrate that immobilization of the Nirmali seed powder into calcium alginate beads did not effectively remove the turbidity of the water.

Keywords: *Bio coagulants, Coagulation, Flocculation, Immobilization, Niramli seed*

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Effect of Cassava Starch and Beeswax-based Coating on Extending Postharvest Shelf life of Papaya (*Carica papaya*) at the Ambient Temperature

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Abstract

Papaya is a highly nutritious tropical fruit, rich in vitamins, minerals, and antioxidants. However, it has a short postharvest life and is highly susceptible to physical damage, moisture loss, chilling injury, disease, and insect damage. Traditional postharvest treatments, such as low temperature and chemical preservatives, are costly with possible health, economic and environmental concerns. This study aimed at determining the effectiveness of cassava starch and beeswax-based edible coating in extending the shelf life and maintaining quality of papaya fruits stored at ambient temperature. Sixty uniformly mature papaya fruits, at the color break stage (approximately 10% yellow), were treated with coatings formulated from varying concentrations of cassava starch (1%, 1.5%, and 2%), combined with beeswax, papaya extract, potassium sorbate, and Tween 80 as an emulsifier. The results indicated that 1% cassava starch treated fruits showed the best performance, delaying ripening and maintaining fruit firmness from 4.56 to 4.16 Pa over 12 days, and maintaining pH from 6.10 to 6.15 and total soluble solid levels (TSS) from 9.00 to 10.73 during storage in relation to uncoated fruits. There were no symptoms of disease in fruits coated with 1% cassava starch, showing the role that it can play in preventing microbial contamination and reducing postharvest losses. Higher concentrations of 1.5% and 2% were less effective, where fruits manifested increased TSS, reduced firmness, and higher disease incidence, indicative of an accelerated ripening process with compromised quality. Therefore, this study pinpoints that 1% cassava starch coating is a non-toxic, inexpensive, and sustainable postharvest treatment against papaya. This provides a feasible and bio-friendly solution to postharvest challenges, adding value to marketability and reduction in losses within the papaya fruit industry.

Keywords: *Beeswax, Cassava, Edible coating, Papaya, Postharvest, Shelf life*

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Investigating the Phytotoxic Effects of Copper-contaminated Soil on Neermulliya (*Hygrophila auriculata*): Impact on Growth and Physiological Responses

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Abstract

Heavy metal contamination is a global environmental issue that affects environmental well-being and human health. Copper (Cu) is an essential micronutrient and a potential toxicant at high concentrations. This study aims to evaluate the phytotoxic effects of Cu on *Hygrophila auriculata* (Neermulliya) by assessing its impact on plant growth, chlorophyll content, and membrane integrity to determine the plant's tolerance limits under varying Cu stress, due to its adaptability and phytoremediation characteristics, which was the reason for its selection. Cu was introduced to the soil at concentrations of 50, 100, 200, and 300 mg kg^{-1} using $CuSO_4 \cdot 5H_2O$, with the untreated soil as a control. A total of 45 plants were cultivated under controlled environmental conditions for 12 weeks; the growth metrics, chlorophyll content, membrane integrity, and tolerance indices were examined. Results indicated a concentration-dependent response to Cu exposure. Compared to the control, 50 mg kg^{-1} and 100 mg kg^{-1} Cu treatments enhanced chlorophyll *b* synthesis without phytotoxicity ($p = 0.011$). Moderate concentrations (T3, 200 mg kg^{-1}) led to the highest total chlorophyll production (43.40 mg g^{-1}, $p = 0.014$). The highest tolerance index was observed at 50 mg kg^{-1}, particularly for root fresh weight (175.01%) and root length (131.55%). Conversely, plants exposed to 300 mg kg^{-1} exhibited the lowest root and shoot growth, increased membrane damage (119.31 µS cm^{-1}, $p = 0.001$), and significantly reduced biomass production ($p < 0.05$), indicating severe phytotoxicity. Comparisons with previous studies support these findings, highlighting the plant's potential tolerance to moderate Cu contamination. Enhanced growth performance at moderate Cu levels suggests a threshold for toxicity, indicating *Hygrophila auriculata*'s ability to withstand moderate levels of Cu stress and it has the potential to remediate and survive in moderate Cu -contaminated environments.

Keywords: *Copper contamination, Heavy metal pollution, Hygrophila auriculata, Phytoremediation, Phytotoxicity*

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Characterization of *Garcinia gummi-gutta* Paste Processing Wastewater for Potential Reuse as a Natural Disinfectant

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Abstract

Sustainable waste management is a crucial factor in most industries. The present study aimed to characterize the wastewater released from the *Garcinia gummi-gutta* paste processing industry for potential reuse in developing new products. Wastewater samples were collected from three stages (WW_S1: after rinsing, WW_S2: after sedimentation, and WW_S3: at the wastewater outlet) of the *Garcinia* paste processing plant. The key water quality parameters, such as pH, turbidity, biochemical oxygen demand (BOD), salinity, electrical conductivity (EC), and total phenolic content were measured in the wastewater from each stage. Excess water from the collected wastewater samples was removed under reduced pressure to obtain crude extracts, and phytochemical screening was carried out. The antibacterial activity of *Garcinia* crude extract (0.5 g/L, 1.0 g/L, 2.0 g/L) and undiluted wastewater samples was evaluated with *Staphylococcus aureus* and *Escherichia coli*. Wastewater was characterized by pH 2.0 - 2.5; turbidity 1000 - 10000 FAU; BOD 2.0 - 3.5 mg/L; salinity 15.00 - 16.75 psu, and EC 25- 32 mS/cm. Phenols, flavonoids, and saponins were identified as phytochemicals in the crude extract. A significantly higher ($p < 0.05$) total phenolic content was recorded as 41.41±1.20 mg GAE/L in WW_S1 compared to 31.56 ± 1.39 mg GAE/L at WW_S2 and 27.00±1.19 mg GAE/L at WW_S3. Also, undiluted WW_S1 showed the highest inhibition value (7.33 ± 0.98 mm) against *E. coli* compared to the commercial liquid cleaner product and other stages. All extracts except 0.5 g/L showed inhibition against *S. aureus*, but values were not significant compared to the commercial product. Overall, WW_S1 exhibited the best activity against *E. coli* and *S. aureus*, along with the highest total phenolic content and yield, makes it a natural substitute for commercial synthetic disinfectants, leading to sustainable waste management.

Keywords: *Anti-bacterial activity, Bioactive compounds, Escherichia coli, Garcinia gummi-gutta, Staphylococcus aureus*

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Application of Hibiscus Flower (*Hibiscus rosa sinensis* L.) in Enhancing Colouration, Growth and Disease Resistance of Koi-carp (*Cyprinus carpio koi*)

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Abstract

Generally, synthetic astaxanthin is used to maintain and enhance the skin colour of ornamental fish. However, it is expensive and causes an increase in the cost of production in aquaculture, as feed costs contribute significantly to the overall production expenses. Therefore, an alternative ingredient for skin coloration should be looked for to replace the high price of synthetic astaxanthin with a cheaper and locally available product. Koi fish (*Cyprinus carpio koi*) is one of the most popular ornamental fish, characterized by its beautiful body shape and vibrant colours, which give it high economic value. To get koi fish production with good colour quality, several supporting factors are needed, one of which is feed. In this study, hibiscus (*Hibiscus rosa sinensis* L.) powder was used as an additive in koi fish feed. The study was conducted using a completely randomised design with doses of hibiscus powder in the feed formulation as a source of anthocyanins, namely 0% (control), 2.5%, and 5%. Feeding was done two times a day with a feeding rate of 5%. Maintenance was carried out for 90 days, and observations of the colour brightness of koi fish were carried out once a week. The 5% hibiscus powder diet resulted in the highest feed efficiency (114.09%), carotenoid content (9.39 µg/g), and specific growth rate (2.09% per day), significantly outperforming the control diet in enhancing the growth, colouration, and feed utilisation of koi carp. As demonstrated by the higher relative percent survival in the 5% treatment group during the *Aeromonas hydrophila* challenge test, this finding further emphasizes the immunostimulatory qualities of hibiscus. For water quality parameters, temperature, pH, and dissolved oxygen levels are still within optimal limits for koi fish. This study supports hibiscus-based diets for improving coloration, growth, and disease control in koi carp, promoting eco-friendly and health-conscious practices in ornamental fish farming.

Keywords: *Disease resistance, Growth performance, Koi carp, Natural colour enhancement*

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Application of Sweet Potato (*Ipomoea batatas*) as a Feed Additive for Colour and Growth Enhancement in Balloon Molly (*Poecilia sphenops*)

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Abstract

The use of sweet potato (*Ipomoea batatas*) as a dietary additive for growth and pigmentation in balloon mollies (*Poecilia sphenops*), a species commonly kept in ornamental aquaculture, was explored in this study over 12 weeks. The experiment included four dietary treatments: a control diet and three treatment diets supplemented with sweet potato flour at varying levels of 6%, 9%, and 12%. Fish growth was measured and monitored through their length, weight, weight gain, specific growth rate (SGR), and average daily gain (ADG), while fish pigmentation was measured by carotenoid concentration and the intensity of colour in the fish's skin. It was observed that fish on the control diet performed relatively better in terms of growth than those on the supplemented diets, although the difference was insignificant. Supplementation levels of 6% to 12% were responsible for an increase in both carotenoid content and colour intensity, as measured by grayscale analysis. It was determined that higher levels (9%, 12%) of sweet potato in the diet resulted in high levels of carotenoid and colouration without significantly affecting the growth of the fish. Based on the differences in water quality parameters for each treatment, the claim that adding sweet potato to the diet is detrimental to the water environment can be refuted. These results indicate that sweet potato can serve as a good natural colour enhancer, but in some cases, intake should be limited to maintain a favourable growth-to-colour enhancement ratio.

Keywords: *Carotenoids, Feed additives, Ipomoea batatas, Pigmentation, Poecilia sphenops*

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Consumer Preference on Using Bio Degradable and Non-degradable Yoghurt Spoons with Special Reference to Hand Made Bamboo Spoons in Sri Lanka

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Abstract

Single use spoons are commonly used in daily life and discarded in large quantities. Hence, it is necessary to find out sustainable alternative resources as raw materials for spoon manufacturing, and those alternatives should be accepted by the consumers. The aim of this research was to determine consumer preferences for plastic, wooden, and handmade bamboo spoons made from *D. asper* through a structured survey based on key factors: the frequency of use, taste, tactile comfort, environmental impact, and purchase intention. A simple random sampling method was used to select 51 participants. We surveyed them using a questionnaire to gather both qualitative and quantitative responses. Participants rated each material based on comfort of use, environmental impact, curviness, health risks, and cost. Chi-square and Kruskal-Wallis tests were used to analyze the data. Plastic spoons were found to be the most frequently used, with 74.5% of participants reporting weekly use. Plastic rated very high on the comfort factor among participants ($p < 0.05$) and was also perceived as fairly inexpensive ($p < 0.05$). On the other hand, bamboo spoons scored significantly high on environmental friendliness ($p < 0.05$), with participants showing high concern over ecological impact ($p < 0.05$). There was little variation in taste perception among participants ($p = 0.889$), while in terms of comfort and design, it appeared to be quite demographic ($p < 0.05$). The survey highlights that alternatives to bamboo spoons should be provided in a manner that maintains both user comfort and affordability. In this respect, bamboo appears to be the best option for those who stress the problem of ecological compatibility, although plastic remains leading in convenience and cost. More importantly, it would be interesting to further investigate how bamboo and wooden spoons can be made more marketable to overcome perceived deficiencies in comfort and design.

Keywords: *Bamboo, Plastic, Spoon, Wood*

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Evaluation of Protein Baits Developed Using Sap Extracts of Selected Cucurbits for Melon Fly Management

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Abstract

The melon fly, *Bactrocera cucurbitae* (Coquillett), is widely distributed across temperate, tropical, and subtropical regions of the world. Over 125 host plants have reported damage from it, making it a major pest of cucurbitaceous vegetables. The extent of losses caused by melon fly damage varies between 30% to 100%, depending on the cucurbit species and the cropping season. Protein baits have been proven effective in managing melon fly populations. This experiment evaluated the attraction of flies to protein baits made from both pumpkin and melon sap. The objectives of the experiment were to determine the attraction behavior of melon flies to different concentrations of each sap tested with yeast protein and to evaluate the effectiveness of the Spinosad poisoning level in terms of melon fly mortality. Yeast hydrolysate and molasses were used as bait ingredients. Three concentrations (5%, 10%, and 20%) of each sap were tested with commercial bait, and distilled water was taken as a control treatment. To test the effectiveness of the Spinosad poisoning, the levels 20% below and above the recommended rate of Spinosad poisoning were compared with the standard rate. The results indicated a significantly higher percentage of the attraction of melon flies for 10% and 20% pumpkin protein bait and 20% melon bait than commercial bait. Regarding melon fly mortality and the cost efficiency of using Spinosad insecticide, less than 25% of the recommended poisoning rate of Spinosad insecticide was found to be effective for poisoning pumpkin and melon sap protein baits.

Key words: *Bactrocera cucurbitae, Cucurbits, Melon fly, Protein bait, Spinosad*

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Development of Vegan Spread using Soymilk (*Glycine max*) & Coconut Milk (*Cocos nucifera*) Incorporated with Garlic (*Allium sativum*) and Pepper (*Piper nigrum*)

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Abstract

There is a trend towards plant-based alternative food production. The consumption of plant-based foods is increasing due to the health benefits of plant-based proteins. This study aimed to develop a vegan spread with Soybean (*Glycine max*) and Coconut (*Cocos nucifera*) milk by adding garlic (*Allium sativum*) and pepper (*Piper nigrum*) to create a product that is flavourful and nutritious through improved nutritional and sensory properties. The Soybean was soaked and blanched before grinding, and the suspension was filtered. Soy milk was produced by adding water and soy pulp in a 2:1 ratio. The coconut kernel was scraped, and coconut milk was produced by adding water. Soy milk and coconut milk were mixed in a 1:1 ratio and heated up to 80°C. Formulation was done by adding vinegar to remove the whey after curd formation. The formulations of the samples were carefully adjusted by varying the curd and garlic content while keeping salt and pepper constant. Treatment 1 (T1) contained 93% curd and 2% garlic, while Treatment 2 (T2) had 91% curd and 4% garlic. In Treatment 3 (T3), the curd content was reduced to 89%, with 6% garlic added. Finally, Treatment 4 (T4) featured the lowest curd percentage at 87%, with the highest garlic content of 8%. Then, the product was placed into spread bottles and stored under refrigerated conditions. Four formulations were developed and subjected to sensory evaluation using a 5-point hedonic scale to determine consumer preferences in terms of aroma, colour, texture, appearance, flavour, spreadability, aftertaste, and overall acceptability. The Trial One (T1) sample received the highest scores across all sensory attributes. The four samples were evaluated by a panel of 30 untrained sensory panellists, and consumer preference scores for T1, T2, T3, and T4 were 14, 9, 5, and 2, respectively. The average values of the proximate analysis results for the selected sample of vegan spread are Moisture (44.90%), Ash (2.3%), Crude Protein (12.19%), Crude Fiber (0.0823%), Crude Fat (33.09%), Carbohydrate (7.43%), and pH (5.0). Coliform, E. coli, Total Plate Count, and Yeast and Mold tests were conducted during the 4th and 8th weeks. At the 4th week, all these tests were negative, but at the 8th week, results showed 24 Total Plate Count, 1 Yeast and Mold colony, Coliform positive result, and E. coli negative result. Moisture value increased, and pH value decreased over time. According to the results, the shelf life was determined to be 2 months. Based on the results, the selected sample (T1) is the best in terms of sensory analysis and proximate analysis. Among all formulations (T1) was found to be the best in terms of sensory analysis, nutritional analysis, and shelf-life stability.

Keywords: *Coconut, Coconut milk, Garlic, Plant-based protein, Soybean, Soymilk, Vegan*
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Abundance of *Vibrio* sp. Isolated from *Macrobrachium rosenbergii* in Seven Reservoirs of Hambanthota and Monaragala Districts, Sri Lanka

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Abstract

Vibrios, essential natural microflora of *Macrobrachium rosenbergii*, are a pivotal aspect to explore because regulating *Vibrio* growth significantly impacts the overall production of *M. rosenbergii*, as Vibrios are opportunistic pathogens that cause detrimental diseases in the species. The present study investigates the abundance of *Vibrio* sp. associated with *M. rosenbergii* captured from seven selected dry zone reservoirs in Sri Lanka. Samples of *M. rosenbergii* were collected from Bandagiriya Wewa, Mahagal Wewa, Ridiyagama Wewa, and Weerawila Wewa in the Hambanthota district, as well as Handapanagala Wewa, Muthukandiya Wewa, and Urusita Wewa in the Monaragala district, from fish landing sites in each reservoir and stored in sterilised polythene bags. The prawn samples were then homogenised and inoculated onto Thiosulphate Citrate Bile Sugar plates using the spread plate method. After incubation, the grown colonies were counted manually and expressed as CFU/g of prawn. The resulting colonies were subjected to a set of biochemical tests to confirm their identity as Vibrios. The abundance of *Vibrio* sp. associated with *M. rosenbergii* from the seven reservoirs was compared using the Kruskal-Wallis Pairwise comparison test. All isolated colonies were confirmed as *Vibrio* sp. based on the biochemical test results. The mean total number of *Vibrio* sp. isolated from Muthukandiya Wewa (8.19 ± 0.84 log CFU/g of prawn) was significantly higher than that from Bandagiriya Wewa (7.03 ± 0.74 log CFU/g of prawn), Handapanagala Wewa (6.92 ± 0.55 log CFU/g of prawn), and Urusita Wewa (6.85 ± 0.35 log CFU/g of prawn). This study concludes that *M. rosenbergii* cultured in the Muthukandiya reservoir contains the highest number of *Vibrio* sp. Further research on the regulation of growth factors for Vibrios is recommended to elucidate the variations in their abundance in these reservoirs.

Keywords: *Culture based fisheries, Abundance, Vibrio, Spread plate method*
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Temporal Variations in the Biofilm Formation Ability of *Vibrio* sp. Isolated from Giant Freshwater Prawn (*Macrobrachium rosenbergii*)

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Abstract

The formation of biofilms by Vibrio-like pathogens is a crucial adaptation that enhances their virulence and survival in harsh conditions. Due to the pronounced resistance exhibited by biofilm bacteria, it is crucial to assess these aspects to implement effective mitigation and preventive measures. The present study examines the temporal variation of biofilm formation by *Vibrio* spp. isolated from *Macrobrachium rosenbergii*. The Vibrios used for the study were isolated from *M. rosenbergii* captured from Sri Lankan reservoirs located in the Hambanthota and Monaragala districts. Ninety-six well microtiter plates were used to determine the biofilm-forming ability of isolated Vibrios at 24 hrs, 48 hrs, 72 hrs, 96 hrs, and 120 hrs post incubation times at room temperature. Following the investigation, the isolates were classified into four categories: Non-Biofilm Formers (NBF), Weak Biofilm Formers (WBF), Moderate Biofilm Formers (MBF), and Strong Biofilm Formers (SBF). Fourteen colonies (41.18%) among thirty-four tested had a perpetual ability to biofilms (nine WBF, four MBF, and one NBF) whilst another thirteen (38.24%) showed an increasing ability in which seven were WBF initially and then became MBF. Three isolates showed no biofilm formation (NBF) at 24 hours post-incubation, and with time, they developed WBF. The other three isolates were WBF at 24 hours, MBF at 48, 72, and 96 hours, and SBF at 120 hours. Of the tested thirty-four colonies, only four colonies showed increasing biofilm-forming ability followed by a declining ability (WBF-24 hrs, MBF-48 & 72 hrs, and WBF-96 & 120 hrs). The remaining three isolates were MBF at 24 hours post incubation and NBF at four other incubation periods. Investigated *Vibrio* sp. showed varying flairs of biofilm formation abilities. These biofilm bacteria, capable of withstanding discrete stress conditions and various host defensive mechanisms and should be properly controlled to mitigate their risk.

Keywords: *Biofilm formation, Post incubation, Temporal variation, Vibrio sp.*
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Root Interaction Study in Banana, Ginger, and Turmeric Plots Intercropped with Immature Oil Palm (*Elaeis guineensis*) in Galle District, Sri Lanka

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Abstract

Intercropping has emerged as a viable agroforestry practice to enhance land use efficiency and productivity, particularly in immature oil palm plantations. This study investigates the root interaction patterns among banana (*Musa spp.*), ginger (*Zingiber officinale*), and turmeric (*Curcuma longa*) under immature oil palm (*Elaeis guineensis*) in Thalgaswella Estate, Galle District, Sri Lanka. Data were collected over a nine-month period, with collections conducted once in every three months. Root samples were collected from four corners of each intercrop plot using a non-destructive method, where a polythene sheet was laid under the soil so that the observation of root distribution was very clear to observe, and root distribution was observed to assess the interaction. In most of the occasions, primary roots were observed in banana plots where ginger and turmeric plots show more tertiary and secondary root interactions. In banana, ginger and turmeric plots there were 21 primary roots discovered. The total of 78 secondary roots were observed throughout the sampling process. Altogether 395 tertiary roots were observed in all three types of intercrop plots. This study provides insights into optimizing intercropping combinations under immature oil palms.

Keywords: *Agroforestry, Intercropping, Oil palm, Root interaction*

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Effect of Seaweed-based Foliar Spray on Growth and Yield Associated with Catalase and Ascorbate Peroxidase Activities of *Capsicum annuum* L.

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Abstract

Plant immunity is the defense mechanism that plants use to protect themselves from harmful effects caused by other organisms and abiotic stress conditions such as salinity, drought, and high light intensity. The antioxidant enzyme activities of catalase (CAT) and ascorbate peroxidase (APX) are two indicators of strong plant immunity. Plant immunity inducers activate or prime plant immunity, and seaweeds are known to enhance this process. The present experiment was conducted to evaluate the effect of seaweed extracts on the growth and yield of *Capsicum annuum* L. (green chili) in relation to CAT and APX activities. Three different foliar applications were prepared by mixing varying ratios of green algae (*Ulva lactuca*) and brown algae (*Stoechospermum marginatum*) extracts: T1 (2:1), T2 (1:1), and T3 (1:2). T4 was a commercialized product (Cropmaster©), and T5 was deionized water. Treatments were arranged in a completely randomized design with three replicates. Results indicated significant differences in CAT and APX activity among treatments. CAT and APX activities were measured using a spectrophotometric method. The highest CAT activity (30.53 µM/min/g FW) was recorded in T2, whereas the lowest (20.39 µM/min/g FW) was observed in T5. Similarly, the highest APX activity (464.06 µM/min/g FW) was recorded in T2, followed by T5 (335.63 µM/min/g FW), while the lowest activity was observed in T4 (65.13 µM/min/g FW). Significant differences were also observed in fruit yield parameters. The highest number of fruits per plant (53) and the lowest (33) were recorded in T2 and T5, respectively. Likewise, the highest fresh fruit weight per plant was in T2 (299 g), while the lowest was in T5 (172 g). The seaweed-based foliar spray prepared with equal proportions of green and brown algae (T2) significantly improved growth and yield parameters in green chili. The results suggest that the enhancement of antioxidant enzyme activity through seaweed extract application may contribute to improved plant resilience, stress tolerance, and productivity.

Keywords: *Ascorbic peroxidase activity, Catalase activity, Foliar spray, Plant immunity, Seaweeds*
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Combined Application of Biochar and Nitrogen Fertilizer on Nitrogen Use Efficiencies and Grain Yield of Rice (*Oryza sativa* L.)

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Abstract

Biochar is a carbon rich material which enhances the soil health and improves the physiological performance of rice crops. It consists of a micro and nano size porous structure, which increases the soil's nitrogen retention capacity. The study investigated the interaction effects of biochar and nitrogen fertilizer on nitrogen uptake, nitrogen utilization, nitrogen use efficiency and rice yield. The field experiment evaluated different nitrogen levels (0, 30, 70, and 100%) based on the recommended nitrogen dose of 105 kg ha^{-1}, along with different rice husk biochar application rates (0, 1, 2, and 3 t ha^{-1}). A split-plot experimental design with three replicates was used during the 2023 Yala and 2023/24 Maha seasons. Soil samples from each experimental unit were collected to determine the initial available nitrogen content. At the harvest, plant shoot and paddy samples of the AT 362 rice variety were analyzed to determine total nitrogen content which had used to calculate the nitrogen uptake efficiency (NUpE), nitrogen utilization efficiency (NUtE) and overall nitrogen use efficiency (NUE). Analysis of variances was performed by using Minitab 17 software. The results showed significant nitrogen uptake efficiencies of 71.04 and 69.15% in 2023 Yala and 2023/24 Maha seasons, respectively, with the highest value observed at 2 t ha^{-1} biochar and 70% nitrogen application rate. Similarly, NUtE (33.69, 33.32%) and NUE (28.56, 28.53%) were highest when 3 t ha^{-1} biochar and 70% nitrogen were applied in both seasons. Compared to the control treatment NUpE, NUtE and NUE were increased by 5.94%, 11.93% and 18.09%, respectively. Furthermore, significant raw paddy yields were recorded as 5.28 to 5.30 t ha^{-1} in 2023 Yala and 5.12 to 5.17 t ha^{-1} in 2023/24 Maha seasons with combine application of 2 to 3 t ha^{-1} biochar and 70 to 100% nitrogen fertilizer rates, which resulted to increase the grain yield by 11.36 to 13.87% and 8.78 to 9.67%, respectively, compared to treatments without biochar. These results emphasized the potential of combined biochar and nitrogen fertilizer application in improving nitrogen use efficiency in rice crops. The incorporation of biochar carbon in paddy production plays an important role in enhancing nitrogen retention and slow-release mechanisms, thereby improving crop yield performances.

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Keywords: *Biochar, Efficiency, Nitrogen, Soil, Yield*

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Effect of Different Fertilizer Schedules on Growth and Yield of Green Chili (*Capsicum annuum* L.) under Controlled Environmental Conditions

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Abstract

One innovative approach to agricultural practices is controlled environmental agriculture (CEA). To maximize crop growth and yield, farmers turn to liquid nutrient formulas such as Albert's solution in CEA. There is a growing interest in investigating other fertilizer substitutes for growing crops in CEA. The present experiment was carried out to compare the effects of six different fertilizer schedules containing *Mugasol, Densol, Medotec* and *Complesal* fertilizer ranges (T1 to T5) with the control being the commonly used Albert solution (T6) for growth and yield of green chilli (*Capsicum annuum* L.) var. MICH-HY1. The experiment was laid out in a completely randomized design with five replications. As growth parameters, plant height and number of leaves per plant were taken at one month after planting and both fresh weight and dry weight of the plant structural biomass were measured at the end of the trial. Yield parameters such as total number of fruits, total fruit weight (g), average weight of a fruit (g) and average length of a fruit (cm) were measured at harvest. The yield suitable for market consumption was quantified using a fruit scoring index. Data were analysed using the SAS statistical software through ANOVA. Mean separation was done by using the Tukey method at a 5% probability level. Significantly ($p < 0.05$) the highest mean plant height (33.4 cm) resulted in T6, while T5 recorded significantly ($p < 0.05$) the highest leaf count. However, the fresh and dry weights of the plant structural biomass were not significantly ($p > 0.05$) influenced by the given fertilizer schedules. The significantly greater total number of fruits was recorded by T1 and T2 schedules, while the average weight and length of fruits were not significantly different among the treatments. As per the results of the fruit scoring index, there was no significant ($p > 0.05$) difference among treatments on the % of fruits in grade 1, 2 and 3. The results indicate that the new fertilizer schedules, based on *Mugasol, Densol, Medotec* and *Complesal* fertilizers, are as effective as the control treatment of Albert Solution, as no significant ($p > 0.05$) differences observed in growth or yield of chili. The new fertilizer schedules utilizing advanced fertilizer types present a promising and effective alternative for growing the MICH-HY1 chilli variety in CEA. This approach provides cultivators with a variety of fertilizer options, eliminating the reliance on a sole type, all while maintaining yield and quality.

Keywords: *Capsicum annuum, Fertilizer schedule, Growth and yield, Protected house*
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Elephant Dung as an Alternative Substrate for Oyster Mushroom (*Pleurotus ostreatus*) Cultivation

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Abstract

Mushrooms are fungi that act as bioconversion agents of lignocellulose in organic waste materials. Consumption of mushrooms is increasing day by day due to their nutritional values. The present experiment aimed to examine the possibility of using elephant dung as an alternative substrate for oyster mushroom (*Pleurotus ostreatus*) cultivation. There were five treatments in the experiment that based on the ratio between sawdust and elephant dung in the substrate: 100% sawdust (T1 - control), 75% sawdust and 25% of elephant dung (T2), 50% sawdust and 50% elephant dung (T3), 25% sawdust and 75% elephant dung (T4) and 100% elephant dung (T5). The experiment was arranged as a completely randomized design with five replicates where each replicate consisted of eight experimental units as grow bags. One-way ANOVA was used to analyze data using SAS statistical package. The growth performances of mycelium and the yield of oyster mushrooms were recorded from the 1st day of bag opening until 50 days. Growth performances were determined by measuring the average mycelia growth as length (cm) and the visual appearance score once a week. The total fresh yield was recorded for 50 days after bag opening. According to the results, mycelia growth and the fresh yield of mushrooms were significantly ($p < 0.05$) different among treatments. The mycelia growth was good in all treatments except the control (T1 - 100% sawdust). The highest fresh mushroom yield was obtained when mixing 50% sawdust with 50% elephant dung (T3) to prepare the growth substrate. The lowest fresh mushroom yield was obtained in the treatment using 100% saw dust (T1), though it recorded greater value of visual appearance score. Furthermore, the growth substrate prepared by mixing equal proportions of sawdust and elephant dung (T3) had the highest value for benefit cost ratio and lowest production cost per bag. Therefore, based on the present study, it can be concluded that 50% of the general mushroom substrate of sawdust can be replaced by elephant dung for oyster mushroom cultivation without compromising the yield.

Keywords: *Alternative mushroom substrate, Elephant dung, Mycelia growth, Oyster mushroom, Sawdust*

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Bacterial Bio-fertilizer Increases Vegetative Growth and Leaf Oil Yield in *Cinnamomum verum* J. Presl Variety *Sri Gemunu*

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Abstract

Sri Lankan cinnamon (*Cinnamomum verum* J. Presl) is the most economically significant spice in Sri Lanka's export market, generating substantial income. However, Cinnamon cultivation relies heavily on chemical fertilizers contributing to elevated production costs and posing significant environmental and health hazards due to overuse. Despite the global demand for eco-friendly agricultural practices, alternative fertilizers for cinnamon remain underexplored. The objective of this research was to determine the effect of two locally isolated *Bacillus spp.* as a soil amendment and foliar spray on vegetative growth and leaf oil yield of widely grown cinnamon variety *Sri Gemunu* (SG) in comparison to commonly used organic alternatives. A completely randomized pot experiment was conducted with five replicates for vegetative data and two replicates for oil yield, using four-month-old SG plants grown in a potting mixture of loamy topsoil, cow dung, coir dust, and soil in a 1:1:1:1 ratio. The treatments included a negative control of topsoil (NC), recommended inorganic fertilizer (F), compost (C), *Gliricidia* leaves (G), strain 1 foliar spray (1F), strain 2 foliar spray (2F), strain 1 to soil (1S), strain 2 to soil (2S), strain 1 to soil with *Gliricidia* leaves (1G) and strain 2 to soil with *Gliricidia* leaves (2G). Vegetative growth parameters and leaf oil yield were measured after 12 months of pot establishment. Vegetative growth parameters of plant height, root length, and leaf number were the highest (101.20 ± 7.36 cm, 118.40 ± 6.81 cm and 191.60 ± 14.80 respectively) in 1S, while 2S recorded the highest stem circumference (3.60 ± 0.59 cm) and SPAD value (56.83 ± 4.48). Inorganic fertilizer supported root growth (118.20 ± 15.22 cm) but showed reduced overall vegetative performance compared to *Bacillus* treatments. The highest leaf oil yield was produced from 1G (21.34 ± 0.82 µL/g). These findings underscore the potential of *Bacillus*-based biofertilizers as a sustainable alternative for improving vegetative growth and oil yield in the Sri Lankan cinnamon industry, reducing reliance on chemical inputs.

Keywords: *Bacteria fertilizer, Cinnamon, Leaf oil, Vegetative growth*

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Analysis of the Genetic Basis of Natural Variation of Flowering Time of Selected Sri Lankan Traditional Rice Accessions in Response to Seasonal Variation

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Abstract

The growing season is critical for most of Sri Lankan traditional rice (SLTR) accessions. The effect of planting date (PD) during the two main growing seasons (*Yala* and *Maha*) on agronomic traits and yield in SLTR remains unclear, and the responsive genetic factors are uncharacterized. This study aimed to evaluate the effects of days to flowering (DF) on yield in response to growing season and characterize key genes responsible for flowering. Ten SLTR accessions (4132, 5530, 4387, 4237, 4290, 4145, 4772, 4731, 6412, 2170) and an improved variety (*Bg 300*) were cultivated under twelve PDs at one-month intervals in Ibbagamuwa, IL1a agro-ecological zone in Sri Lanka. DF, plant height (PH) at flowering, and number of spikelets per first panicle (SP) were significantly influenced by accession and planting date ($p < 0.05$). Regression analysis revealed a quadratic or linear relationship between DF and SP. Effect of environmental factors on DF, PH and SP were revealed. PCR was performed for selected six key genes responsible for flowering time. The polymorphic information content (PIC) values were computed and hierarchical cluster analysis was performed based on flowering time gene variation. Three accessions were selected (4237, 5530 and 6412) representing the clusters to study the effect on DF and yield components through exposure to controlled short-day (SD), day-neutral and long-day (LD) photoperiods. The ANOVA revealed that DF and SP were significantly ($p < 0.05$) affected by photoperiod. The SD resulted in the significantly reduced DF in three accessions. The increased DF reduced the SP in accessions 5530 (r = -0.51) and 6412 (r = -0.53) according to the regression analysis ($p < 0.05$). *Hd1* and *Ghd7* interactions mediated late-flowering under LD while the absence of *Ghd7* pathway mitigated the delayed flowering response. *DTH8*-mediated suppression of *Ehd1* and *Hd3a* under LD, led to delayed flowering and a simultaneous increase in SP. Alternatively, the *Ehd1-RFT1* pathway facilitated early flowering under SD conditions in the absence of *Hd1.*

Keywords: *Days to flowering, Environmental effect, Rice, Yield*
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Use of *Bacillus sp*. on Yield Improvement and Control of Brown Spot Disease in Rice (*Oryza sativa)* Variety Bg 300

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Abstract

Brown spot disease (BSD), caused by *Bipolaris oryzae* (*Bo*), is a major contributor to yield losses in Asia. Synthetic fungicides and fertilizers are used for higher yields. However, synthetic agrochemicals pose adverse environmental and health impacts. Therefore, developing alternatives for disease management and nutrient supply is important in sustainable agriculture. This study aims to assess a selected bacterial isolate (*Bacillus sp.*) against *Bo* under *in vitro* conditions, evaluate its effect on BSD suppression, and determine its impact on yield in rice variety Bg 300. *Bo* was isolated and identified based on mycelial and spore morphology. The poisoned food technique was used to evaluate *Bacillus sp*. (BF) on mycelial growth. Two greenhouse experiments were arranged in the complete randomized design to determine the effect of BF on vegetative growth and yield of Bg 300 under *Bo*-inoculated (*B*IC) and BSD-free conditions (BFC). Recommended inorganic fertilizers and BF non-inoculation served as positive (PC) and negative control (NC) respectively. BF significantly suppressed ($p < 0.05$) *Bo* with a mycelium diameter of 6.7 ± 0.65 cm in contrast to that of NC (9 ± 0.00 cm). Plants with BF inoculation under BFC showed a significantly better performance ($p < 0.05$) than those under *B*IC. Plant height (PH) was 83.0 ± 2.5 cm under BFC and 82.67 ± 2.08 cm under *B*IC in BF, whereas in NC, PH was 75.89 ± 1.3 cm and 75.24 ± 2.4 cm, respectively. In PC, PH was 81.78 ± 2.04 cm under BFC and 84.11 ± 1.8 cm under *B*IC. The SPAD meter reading of the flag leaf (SF) was 40.77 ± 0.4 under BFC and 39.76 ± 0.7 under *B*IC in the BF. In NC, SF was 31.71 ± 2.08 and 28.62 ± 0.88, while in PC, it was 43.84 ± 0.6 and 44.76 ± 0.7 under disease-free and inoculated conditions, respectively. The total yield per plant (TY) in BF was 151.89 ± 23.8 g under BFC and 92.67 ± 3.4 g under *B*IC. In NC, TY was 75.5 ± 5.7 g and 62.86 ± 7.2 g, while in PC, it was 161.13 ± 19.7 g and 159.11 ± 19.7 g under BFC and *B*IC, respectively. These findings suggest that BF holds promise as an alternative strategy for brown spot disease suppression and yield enhancement in rice cultivation.

Keywords: *Bipolaris oryzae, Biofertilizers, Brown spot disease, Rice, Yield*

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Reducing Ammonia Emission by Adding Different Levels of Single Super Phosphate During Decomposition of Poultry Droppings

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Abstract

One of the major issues in the poultry industry is the large-scale waste accumulation, which can lead to disposal and pollution problems. Due to high nitrogen content, poultry droppings can be used as a nitrogenous soil amendment after composting. However, up to 50 - 88% of the total nitrogen (TN) may be volatilized as ammonia (NH_3) during decomposition. This study aims to evaluate the effectiveness of different levels of single super phosphate (SSP) as additives to mitigate NH_3 emission during decomposition of poultry droppings. Poultry layer droppings within seven days were collected as the raw material and allowed to decompose for 42 days. Five treatments were designed with varying levels of SSP addition: 0%, 22%, 26%, 30%, and 34% on a dry weight basis, as T_1, T_2, T_3, T_4 and T_5, respectively. Treatments were tested in a completely randomized design with four replicates. Samples were collected on the 0, 14th, 28th, and 42nd day from each pile and pH, EC and TN were measured. The NH_3 emission was determined in the laboratory by enclosure venting method. ANOVA was adapted in data analysis and means were compared by using Dunnett's Test at 5% probability level. Initial poultry droppings had 4.5% TN. The pH and EC were 8.0, and 1.0 mS/cm, respectively. There was no significant difference ($p > 0.05$) in TN and NH_3 emissions among treatments on 14th and 28th days. The pH ranged from 8.4 to 8.6, and the EC ranged from 6.6 to 9.2 mS/cm in all treatments on day 42. On 42nd day, the significantly higher ($p < 0.05$) values for TN (2.2% and 2.3%) were obtained by T_4 (30% SSP) and T_5 (34% SSP) respectively, compared to control (T_1). Meanwhile, lower values of NH_3 (138.7 mg and 151. 9 mg) was obtained by T_4 (30% SSP) and T_5 (34% SSP), respectively. Therefore, T_4 is the optimum amount of SSP added poultry dropping treatment (30% SSP), which is an effective way to increase the TN while reducing NH_3 emission.

Keywords: *Ammonia emission, Pollution, Poultry droppings, Total nitrogen, Waste*

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Effects of Different Application Rates of Seaweed-based Bio Stimulant on Growth and Yield of Chili (*Capsicum annuum*) Cultivation under Protected House Conditions

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Abstract

Biostimulants derived from different seaweeds have been found to boost plant health, increase photosynthetic activity, and improve plant resistance. This study was aimed to evaluate the effect of different application rates of Wokozim®, a granular bio stimulant from seaweed (*Ascophyllum nodosum*), on growth and yield of chili (*Capsicum annuum*) cultivation under protected house conditions. Four treatments as T_1 (Control-0 g/plant), T_2 (5 g/plant), T_3 (10 g/plant), T_4 (15 g/plant), were tested using a completely randomized design with five replicates. Albert solution was added to each plant at the rate of 0.1 g, three times per week, increasing weekly by 0.1 g until reaching 1 g/plant. Plant height and number of leaves/plant were measured at 50% flowering and 1st harvesting stages. Number of pods and weight of pods/plant and length of pod were recorded at harvesting. ANOVA was adapted for the analysis of data and means were compared by using Dunnett's Test at a 5% probability level. The results revealed that, the significantly ($p < 0.05$) higher values for plant height at 50% flowering stage (69.95 $\pm$ 1.25 cm, 71.19 $\pm$ 1.58 cm and 71.09 $\pm$ 1.54 cm) were obtained by T_2, T_3 and T_4 respectively, compared to the control (T_1). Further, significantly ($p < 0.05$) higher values for plant height at 1st harvesting stage (101.16 $\pm$ 3.25 cm and 100.79 $\pm$ 3.12 cm) were resulted by T_3 and T_4 respectively, compared to the control. The significantly ($p < 0.05$) highest values for number of leaves/plant at 50% flowering stage (102 $\pm$ 3.20) and at 1st harvesting stage (268 $\pm$ 4.28), number of pods/plant (32 $\pm$ 0.80), weight of pods/plant (164.31 $\pm$ 3.02 g) and length of pod (6.98 $\pm$ 0.30 cm) were obtained by T_4 compared to the control. Therefore, according to the results, T_4 (15 g/plant) can be recommended as the best application rate of Wokozim® for better growth and yield performances of chili (*Capsicum annuum*) cultivation under protected house conditions.

Keywords: *Commercial, Chili, Growth and yield, Organic, Seaweed, Wokozim*

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Evaluation of Particle Size of Coco Peat and Short Fine Coconut Fiber on Nursery Pellets for Vegetable Seedlings

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Abstract

Commercially, in hydroponic cultivations, coir peat is mainly used to produce nursery pellets. However, to improve the quality and to reduce the waste from coconut pellet production (known as short fine fibres), it can be blended with coco peat. Therefore, this study was conducted to develop nursery pellets using a blend of coco peat with short fine coconut fibre for raising vegetable seedlings. Brinjal (variety Josophina) and chili (variety MICH HY01) were used as experimental crops. Ten treatments were prepared using fine short coconut fibre (FSCF) and coco peat (CP) in a 1:1 ratio, such as T1 (< 1 mm FSCF + 0.5 mm CP), T2 (< 1 mm FSCF + 0.5 mm - 1 mm CP), T3 (< 1 mm FSCF + 1 mm - 2 mm CP), T4 (1 mm - 2 mm FSCF + 0.5 mm CP), T5 (1 mm - 2 mm FSCF + 0.5 mm - 1 mm CP), T6 (1 mm - 2 mm FSCF + 1 mm - 2 mm CP), T7 (> 2 mm FSCF + 0.5 mm CP), T8 (> 2 mm FSCF + 0.5 mm - 1 mm CP), T9 (> 2 mm FSCF + 1 mm - 2 mm CP), T10 (commercial nursery pellet). Completely randomized design with three replicates was used as the experimental design. The pH and EC of pellets, germination percentage, plant height, stem girth, number of leaves, dry weight of the seedlings, and Vigor index were measured. ANOVA was adapted to analyse the data statistically. Means were compared using Duncan's Multiple Range Test at a 5% probability level. According to the results, pH (5.5 - 6.5) and EC (< 600 µS/cm) of all treatments were at standard levels. Further, results revealed that for chili, significantly higher germination rates, Vigor index, plant height, stem girth, and dry weight were observed in T5, T6, T8, T9, and T10, and for brinjal, significantly higher values for these parameters were recorded in T5, T6, and T10. Because the blended media improved water retention and aeration, enhancing root growth, nutrient uptake, and overall vigor in both crops. Therefore, a blend of coco peat and short fine fibre improves the performance of nursery pellets while improving the growth of brinjal and chili seedlings.

Keywords: *Coco peat, Fine short fiber, Hydroponics, Nursery pellet, Vegetable seedlings*

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Machine Learning-based Smart Floor Tile Recommendation System for Optimized Indoor Aesthetics and Functionality

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Abstract

This research focuses on developing a machine learning-based recommendation system to choose the optimal floor tile color and design for indoor spaces to improve living spaces' aesthetics, comfort, and functionality. This system is designed for homeowners, architects, and interior designers, enabling them to select tile colors based on three critical architectural factors: the indoor space (large or small), lighting conditions (low or bright), and light temperature (warm or cool). The physical appearance of a space and the mental well-being of its occupants are all influenced by these contextual elements. By exploiting architectural principles that emphasize the interaction of light and space, the system offers personalized tile recommendations that support both visual and emotional design goals that promote relaxation and psychological comfort. Leveraging deep learning, the system classifies space types and lighting conditions to generate personalized tile recommendations that align with visual and emotional design principles. Three deep learning models, EfficientNetB3, ResNet50, and VGG16, were trained using a dataset of 4,540 images, allocated as 70% for training, 15% for validation, and 15% for testing. Among these models, EfficientNetB3 demonstrated the highest classification accuracy for indoor spaces (88.19%), while ResNet50 achieved superior performance in classifying lighting conditions (87.33%) and light temperature (90.67%). The recommendation engine integrates these classifications with expert-approved tile selections, ensuring choices that enhance spatial ambiance while promoting relaxation and psychological comfort. This study bridges the gap between architectural aesthetics and human well-being, offering a smart tool for modern design. The system also holds potential for expansion into home automation and outdoor applications, contributing to the future of intelligent interior design solutions.

Keywords: *Deep learning models, Floor tiles, Image processing, Tile recommendation*

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Gradient-based Meta-learning for Enhanced Zero-day Attack Detection in Network Intrusion Detection Systems

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Abstract

This research investigates the application of Gradient-based Meta-learning (GBML) and Model-agnostic Meta-learning (MAML) techniques for improving zero-day attack detection in Network Intrusion Detection Systems (NIDS). Traditional methods using labeled data are ineffective against novel attacks exploiting previously unknown vulnerabilities. Our study demonstrates how meta-learning approaches can improve adaptability and detection accuracy for zero-day attacks. The proposed framework utilizes the NF-UQ-NIDS dataset and develops meta-learning models for both anomaly detection and zero-day attack classification. The models were trained using 34 network traffic features including IP addresses, port numbers, protocol identifiers, packet metrics, flow duration, throughput values, and TCP/DNS parameters. Experimental results demonstrate that the GBML framework outperforms MAML significantly. For zero-day attack detection, GBML achieved 86.15% accuracy, 84.32% precision, and 85.67% recall, compared to MAML's 67.24% accuracy, 65.48% precision, and 66.91% recall. For normal traffic detection, GBML attained 85.08% accuracy with 83.75% precision and 84.26% recall. These results indicate that GBML provides better generalization and efficiency for dynamic, real-world cybersecurity applications. This research contributes to the growing body of knowledge in applying advanced machine learning techniques to combat evolving cyber threats, highlighting the need for scalable and adaptive solutions to protect network infrastructures.

Keywords: *Gradient-based Meta-learning, Model-agnostic Meta-learning, Network Intrusion Detection Systems, Zero-day vulnerabilities*

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Machine Learning-based Prediction of Optimal Rubber Tapping Days: A Case Study at Dartonfield Estate, Sri Lanka

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Abstract

In Sri Lanka, rubber is a key agricultural industry, and improving its yield is crucial for sustainability. Rubber harvest depends on both the quality and quantity of the yield, which are influenced by environmental factors such as temperature, humidity, and rainfall. Identifying optimal tapping days is essential, as they directly impact on yield and dry rubber content (DRC), enhancing both productivity and economic efficiency. However, due to fluctuating environmental conditions, accurately predicting the best tapping days remains challenging. This study proposes a machine learning-based approach to model the relationship between rubber yield, DRC, and environmental factors. The predictive model estimates optimal tapping days by analyzing historical weather data, tapping schedules, and yield performance. Machine learning techniques, including regression models and time series forecasting, are utilized to enhance prediction accuracy, achieving a reliability of 77.27%. The primary objectives are to determine the best tapping days and improve yield volume and DRC predictions. The implementation involves calculating daily average weather parameters from historical data, which are then fed into the model to forecast DRC and yield volume. By detecting weather and yield patterns, the model recommends optimal tapping days within a given week, minimizing wastage and maximizing efficiency. Furthermore, this research contributes to improved crop management and resource allocation, ensuring higher production and sustainability in rubber farming. The proposed model is specifically applicable to Dartonfield Estate, Sri Lanka, providing valuable insights for farmers to optimize tapping schedules and reduce wasteful tapping practices.

Keywords: *Machine learning, Optimal tapping days, Predictive modeling*

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A Region of Interest-aware Motion Vector and Optical Flow Generation Model for Autonomous Driving

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Abstract

As a growing shift in autonomous driving, in addition to 3-dimensional perception of the surrounding area, the dynamics of the objects are important to result in better driving performance with low collisions. Some existing works have considered optical flow for autonomous driving and have tracked the trajectory of vehicles using a bird's-eye view. These works lack focus on regions of interest (RoI) as they track objects without prioritization, can suffer from object occlusions, and suffer from situational non-awareness. Thus, in order to cater to this research gap, in this work, we propose to use the driver's perspective to first obtain the RoI by identifying moving objects - pedestrians and vehicles - using a novel divide-and-conquer algorithm to generate multiple level 2D bounding boxes using a segmented image, tackling overlapping segments using pixel matching. Next, for the determined RoI, we generated the optical flow by considering a weighted energy functional to prioritize RoI compared to other areas, ensuring data fidelity and smoothness in the interested areas. Finally, two segmented images are utilized for motion vector generation, where we perform the augmented template normalized cross-correlation in the neighborhood of RoI to determine the motion of objects, which mitigates the effect of object changing (using augmentation), false positives (using neighborhood search), and partial template (using template splitting) problems. After template matching, the centroids of the previous object and new object are utilized to derive the motion vectors, which represent the relative motion of objects with respect to the driving vehicle. We obtain a dataset from the CARLA simulator and the KITTI dataset to evaluate the performance of the proposed technique. The results show that motion vectors resemble the real relative velocities of the objects (error < 7.5%), and the proposed RoI determination (error < 6.8%) and optical flow finding (error < 4.5%) models are effective.

Keywords: *Autonomous driving, Image processing, Motion vector, Optical flow*

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A Relative Motion and Driving Action-based Link Lifetime Estimation Model for Vehicular Networks

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Abstract

Vehicular networks are characterized by high mobility, and frequent topology changes occur in them. Due to this, the links among the vehicles are volatile and can exist for a short amount of time compared to other networks. Thus, in order to develop efficient communication among vehicles without packet losses, knowledge of the lifetime of links is very important. Existing works in this domain have considered only sensor-based readings to predict the link lifetimes. However, we foresee that predicting link lifetimes only using sensor readings can bring less correct estimations since they do not have any information on how the vehicle is likely to behave in the future time step. In order to cater to this problem, we propose to obtain driving action outputs: steering angle and throttle with brake values to optimize sensor readings such that the relative motion information is more futuristic. Specifically, we compute jerk using changes in throttle and compute average values for acceleration and velocity by integrating them and combining them with the sensor readings. Next, when the steering angle changes compared to the previous timestep, we compute new components of the motion components considering the steering angle change. We proposed to use non-linear optimization to model the link lifetime estimation task, considering relative motion between vehicles, incorporating jerk, and adjusting with driving outputs. However, due to the high computational complexity of that approach, we also propose a deep neural network-based suboptimal approach in order to reduce the computational complexity. The system is simulated using CARLA for autonomous driving using a pre-trained model and NS3 for vehicular communication. The results show that the proposed models' link lifetime predictions are much closer to real link lifetimes (mean absolute error < 150 ms) compared to existing approaches; thus, the proposed technique can be utilized to improve vehicular communication.

Keywords: *Driving action, Link lifetime, Optimization, Reliable communication, Vehicular networks*

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A Cost-efficient and High-performing FPGA Design and Implementation of a MIMO-OFDM Transceiver for Video Communication

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Abstract

Multiple Input Multiple Output (MIMO)-Orthogonal Frequency Division Multiplexing (OFDM) involves the transmission of modulated data in multiple spatial streams where each stream consists of multiple orthogonal subcarriers. However, we have observed that existing hardware implementations of MIMO-OFDM systems incur high hardware resources and are less suitable for implementation, especially in low-power embedded systems. In order to address this research gap, we designed and implemented a low-cost MIMO-OFDM system suitable for video transmission in a Field Programmable Gate Array (FPGA), still maintaining high performance requirements demanded by video communication. Specifically, a system with programmable pilot sequences and a modulation technique consisting of an inter- and intra-pixel interleaver and a 3-stage BCH code was designed that can correct up to 5 bits per pixel. A precomputed Lookup Table (LUT) and a simplified third-order generator polynomial were used to reduce the complexity of the error correction code. Synchronization was done at the receiver with LUT-based square root approximation, shift register-based correlators, and Karatsuba-like multiplications with fixed-point arithmetic. The hardware complexity was further reduced by time division multiplexing among the four streams and pipelining was used within OFDM stages. The channel matrix was estimated using the least squares method and adaptive channel equalization was performed with mitigated noise amplification by computing the infinity norm of the difference between the last known channel matrix and the present channel matrix to decide whether to proceed with singular value decomposition for computing the inverse of the channel matrix. Finally, the system was implemented on Artix 7 FPGAs and verified using extensive simulations and tested for real data communication, and results showed that the proposed system is power efficient (< 20 W), has high throughput (around 70 Mbps for QPSK), has low cost (< 20000 LUTs and flip-flop), and has low latency (< 1000 μs) compared to existing techniques.

Keywords: *Fiel programmable gate array, orthogonal frequency division multiplexing, video communication, embedded systems*
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A Trust Score Driven Zero Trust Architecture Model for Enhanced IoT Security in Testbed Environments

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Abstract

The rapid expansion of Internet of Things devices presents significant security challenges that traditional perimeter-based security models fail to handle. Existing IoT security solutions, which are mostly perimeter based, often lack the dynamic, context-aware measures needed to address evolving threats in distributed environments. This research introduces a novel trust score model integrated with Zero Trust Architecture principles and Anomaly Detection for IoT networks. The main objective of the study is to monitor the behavior of the IoT devices and assess their security status in real-time. The approach incorporates continuous authentication, least privilege access, and micro-segmentation within a practical IoT testbed. Security analysis is enhanced through a trust scoring system, behavioral monitoring, and a Zero Trust Policy Engine. To assess device trust scores, a trust score equation is developed using the Analytical Hierarchy Process (AHP), which is employed due to its effectiveness in handling multiple security attributes. AHP's structured decision-making framework ensures accurate trust score calculation in a real time environment. This score dynamically adjusts based on selected attributes, enabling contextual and responsive threat mitigation. The proposed model's strength is significantly improved by tightly integrating with ML-based anomaly detection offering improved responsiveness to emerging threats. By embedding these principles into a scalable ZTA framework, this research offers guidelines for implementation and contributes to IoT security with a comprehensive, adaptable defense mechanism. The simulation results from various vulnerable and benign scenarios reveal distinct trust score variations, highlighting the model's effectiveness in evaluating the vulnerability level of IoT devices. The study demonstrates that a trust score-based ZTA can address the limitations of static security models, providing a practical solution for the expanding IoT landscape.

Keywords: *Anomaly detection, Internet of things, Network security, Trust score, Zero trust*

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University Teachers' Administrative Process Automation System

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Abstract

The University Teachers' Administrative Process Automation System (UTAPAS) is a software solution designed to automate and streamline the process of completing the manual forms used in university administration. With dedicated functionalities for examination duty claims, paper marking, and reimbursement claims, the system serves the lecturers, the heads of departments, and the administrators through a standard interface for submitting, approving, and tracking the status of their forms. UTAPAS enhances efficiency by simplifying the submission process. Upon entering the required details, the system will automatically submit the form and send it to the respective head of the department for initial approval. Once approved, the request will progress through a structured approval workflow involving primary administrative units such as finance and the dean's office, with all the necessary authorizations secured. The platform removes the inefficiency associated with paperwork processing by offering a user-friendly interface, role-based access controls, and real-time application status. Lecturers can submit forms that are reviewed sequentially by HODs and relevant administrative staff, with each stage accompanied by status updates and notifications. The system is developed on modern technologies like JavaScript, React, and Firebase, making it scalable and accessible through standard web browsers. Extensive testing across diverse user roles has demonstrated the platform's efficiency as a robust and trustworthy administrative automation tool. Thus, UTAPAS is a reliable platform for university administration, offering an automated system for submitting various types of forms and minimizing inefficiencies in document processing.

Keywords: *Firebase, JavaScript, React, Role-based access, Workflow management*

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Automated Question Paper Grading System for Multiple Choice Questions

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Abstract

Paper grading is a repetitive and time-consuming task that can be automated to allow academics to focus on more productive activities like teaching and research. While digital MCQ quizzes can be graded instantly, most exams still rely on paper-based answer sheets. To automate the grading process, this paper presents an Automated Paper Grading System for Multiple-choice questions (MCQs) that combines a high-accuracy computer vision model with a user-friendly web application. This system enables users to upload answer scripts and model answers, automatically grade them, and ultimately visualize the results. After uploading the answer sheet, the system processes the image through several computer vision techniques to extract and evaluate responses. First, the image is converted to grayscale, followed by edge detection to identify the sheet's corners. Contour detection then locates the largest rectangles containing student responses. Warp perspective transformations are applied to each column to ensure accurate alignment. Finally, a pixel threshold method determines the marked answer by identifying the highest white pixel density within each section. The web application is built using PostgreSQL, Express, React, and Node (PERN stack) and deployed on Google Cloud. Further, it utilizes Python and OpenCV to process scanned MCQ sheets by identifying answers marked in colour using pixel value analysis, leveraging computer vision technology. The study demonstrates that this system achieved 100% grading accuracy with the guidelines followed under standard conditions, taking an average of around 30 seconds to grade 250 answer scripts. Hence, the system ensures precision and efficiency offering a reliable solution for managing large batches of assignments compared to manual grading. Future improvements include extending the system's capabilities to evaluate textual and essay-type answers, further reducing manual intervention.

Keywords: *Automated question paper grading, Computer vision, Multiple-choice questions, PERN stack, Python*

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The Relationship between Environmental Management and Financial Performance: Mediating Role of Environmental, Social and Governance and Competitive Advantage

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Abstract

This paper investigates the relationship between environmental management and organizational financial performance mediated by environmental, social, and governance (ESG) and competitive advantage in hotels in the Southern Province of Sri Lanka. Despite extensive research on these topics, there is considerable debate and conflicting arguments regarding the relationship between environmental management, ESG disclosure, competitive advantages, and financial performance. Six hypotheses were developed based on the constructed conceptual framework. The data were collected using a self-administered survey technique from 110 respondents of Star category hotels, Boutique hotels, Boutique villas, and Tourist hotels in the Southern Province, Sri Lanka, through purposive sampling. Structural equation modelling was performed to explore the relationship between environmental management and the financial performance of the hotels, mediated by ESG disclosure and competitive advantages. The results of LM tests indicate adding a path between environmental management (EM) and financial performance (FP), showing that ESG is fully mediated in the relationship between EM and FP. It would be good if future research selects hotels in different tourist destinations to see where the same relationship exists between environmental management and financial performance. The contribution made in this study has been stated explicitly and tests the relationship between environmental management and financial performance by mediating ESG disclosure and competitive advantage in one model. The selected variables are interconnected, and environmental management practices undoubtedly cause organizations to modify processes and procedures to consider environmental matters across all operations functions; thereby, environmental management activities enhance financial performance. Another research finding is a positive and direct relationship between ESG disclosure and financial performance. Future research can focus on studying environmental management and performance in different industries with different mediating variables that may explain the relationship more precisely.

Keywords: *Competitive advantages, Environment, Environmental management, Financial performance, Hotel industry, Social and governance*
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සේවක පුහුණුව සේවක කාර්යසාධනයට හා වෘත්තීය සංවර්ධනයට ඇතිකරනු ලබන බලපෑම

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[b]*කළමනාකරණ සහ මූල්‍ය පීඨය, රුහුණ විශ්වවිද්‍යාලය, ශ්‍රී ලංකාව*

සාරසංක්ෂේපය

ඕනෑම ආයතනයක සාර්ථකත්වය කෙරෙහි මානව සම්පත සැලකිය යුතු දායකත්වයක් සපයනු ලැබේ. මානව සම්පත් කළමනාකරණයේදී පුහුණුව බලගතු මෙවලමක් ලෙස හඳුනාගනු ලබන අතර එය ආයතනයේ සේවකයන්ගේ දක්ෂතා හා දැනුම වර්ධනය කර ගැනීම සඳහා උපකාරී වේ. මෙම පර්යේෂණයේ අරමුණ වූයේ සේවකයන්ට ලබාදෙන පුහුණුව සේවක කාර්යසාධනයට හා වෘත්තීය සංවර්ධනයට ඇති කරන බලපෑම හම්බන්තොට දිස්ත්‍රික්කයේ සේවය කරනු ලබන සංවර්ධන නිලධාරීන් ඇසුරින් පරීක්ෂා කිරීම වේ. මෙම ප්‍රධාන අරමුණට අමතරව සේවක පුහුණුව සේවක කාර්යසාධනය කෙරෙහි ඇති කරනු ලබන බලපෑම, සේවක කාර්යසාධනය වෘත්තීය සංවර්ධනය කෙරෙහි ඇති කරනු ලබන බලපෑම සහ සේවක පුහුණුව වෘත්තීය සංවර්ධනය කෙරෙහි ඇති කරනු ලබන බලපෑම හඳුනාගැනීම යනුවෙන් උප අරමුණු තුනක් හඳුනාගන්නා ලදී. මෙම ක්ෂේත්‍රයට අදාලව ඉදිරිපත් කර තිබූ සාහිත්‍ය විශ්ලේෂණයන් හා නිරීක්ෂණයන් අනුව විවිධ රටවල සිටින පර්යේෂකයන්ගෙන් බහුතරයක් සේවක පුහුණුව, සේවක කාර්යසාධනයට හා වෘත්තීය සංවර්ධනයට ඇතිකරනු ලබන බලපෑම පරීක්ෂාවට ලක්කර තිබූ අතර ශ්‍රී ලාංකික සංදර්භය තුල පර්යේෂකයන් සීමිත සංඛ්‍යාවක් මෙම ක්ෂේත්‍රයෙහි අධ්‍යයනයක් සිදුකර තිබුණි. එමනිසා ගෝලීය පර්යේෂයන් විසින් හඳුනාගත් නිරීක්ෂණයන් ශ්‍රී ලංකාව තුල මෙම ක්ෂේත්‍රයේ අධ්‍යනයන් කළ පර්යේෂකයන්ට හඳුනාගැනිමට නොහැකිවීම මත වූ හිඩැස පිරවීම සඳහා හම්බන්තොට දිස්ත්‍රික්කයේ සේවය කරන සංවර්ධන නිලධාරීන් 150 ක පමණ නියැදියක් ඇසුරින් මෙම පර්යේෂනයෙදී උත්සාහ කරන ලදී. අධ්‍යයනයේදී සේවක පුහුණුව ස්වායත්ත විචල්‍යයක් ලෙසද කාර්යසාධනය මධ්‍යස්ථ විචලයයක් ලෙස හා වෘත්තීය සංවර්ධනය පරායත්ත විචල්‍යයක් ලෙස භාවිතා කර ඇත. නියැදියට දිස්ත්‍රික්කය තුල පිහිටි මධ්‍යම හා පළාත් රාජ්‍ය සේවයේ නිලධාරීන්ට ඇතුලත් වීමට සමාන අවස්ථා සැලසෙන පරිදි සමාජ මාධ්‍යජාලා හරහා ප්‍රශ්නාවලිය විද්‍යුත් ක්‍රමයට ඉදිරිපත් කර ඔවුන් දක්වන දායකත්වය මත තොරතුරු රැස්කර ගත් අතර, එම තොරතුරු විශ්ලේෂණය කිරීම සඳහා SPSS සහ Smart PLS මෘදුකාංග භාවිතා කරන ලදී. මෙහිදී ජනවිද්‍යාත්මක තොරතුරු සහ පසුබිම් තොරතුරු පරීක්ෂා කිරීමට විස්තරාත්මක සංඛ්‍යානයද, විචලනයන් කෙරෙහි ඇති කරන බලපෑම හඳුනාගැනීම සඳහා ප්‍රතිපායන විශ්ලේෂණය සහ ගොඩනගන ලද කල්පිතයන් (Hypothesis) පරීක්ෂා කිරීම සඳහා Regression analytical tools භාවිතා කරන ලදී. පර්යේෂණය අවසානයේදී අධ්‍යයනයේ සොයාගැනීම් ලෙස සේවක පුහුණුව සේවක කාර්යසාධනයට හා වෘත්තීය සංවර්ධනය කෙරෙහි බලපෑමක් ඇතිකරන බවට හඳුනාගන්නා ලදී.

Keywords: *සේවක පුහුණුව, සේවක කාර්යසාධනය සහ වෘත්තීය සංවර්ධනය*

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A Study on the Perception of Candidates on Recruitment and Selection Process for Academic Positions

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Abstract

The selection of new employees is a critical determinant of an organization's capacity to achieve competitive objectives and ensure operational stability. This research study examines the recruitment and selection processes implemented in the appointment of academic staff. Data were collected through purposive sampling from all candidates who participated in selection interviews for academic positions at the University of Ruhuna between 2022 to February 2024. Quantitative data were obtained via a questionnaire designed to assess candidates' perceptions using a five-point Likert scale. The questionnaire evaluated five primary factors consisting of 26 subfactors. The analysis utilized a mixed-methods approach, incorporating weighted mean analysis, frequency analysis, correlation analysis, and multiple regression analysis. A significant positive correlation was identified between candidates' perceptions of the recruitment and selection processes and various recruitment activities, including the interview structure, the composition of the interview panel, and the reliability of the selection criteria. The study further examined the elements and sub-elements that influence the differing perceptions of candidates regarding the recruitment and selection process. The study did not reveal a significant relationship between demographic variables such as age, gender, civil status, highest educational qualification, and field of study and candidates' perceptions regarding the recruitment and selection process. This research reinforces the application of organizational justice theory in understanding candidates' perceptions throughout the recruitment and selection process. Research indicates that candidates who have a strong understanding of digitalized online application systems are more likely to demonstrate their abilities and preference for using such systems.

Keywords: *Academic staff, Perception, Recruitment, Selection*

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ශ්‍රී ලංකාවේ ගෘහ විදුලි උපකරණ මිලදී ගැනීමේදී සන්නාම විශ්වාසය හා සන්නාම ප්‍රතිරූපය තුලින් බිහිවන පාරිභෝගික තෘප්තියෙහි ස්වභාවය මත සන්නාම පක්ෂපාතීත්වය ඇතිවීම අධ්‍යයනය කිරීම

ජේ.එච්.අයි. මධුරංග[a], ටී.එස්.එල්.ඩබ්ලිව්. ගුණවර්ධන[b]*

[a]පශ්චාත් උපාධි පීඨය, රුහුණ විශ්වවිද්‍යාලය, ශ්‍රී ලංකාව
[b]කළමනාකරණ සහ මූල්‍ය පීඨය, රුහුණ විශ්වවිද්‍යාලය, ශ්‍රී ලංකාව

සාරසංක්ෂේපය

ශ්‍රී ලංකාවේ ඉලෙක්ට්‍රොනික ගෘහ විදුලි උපකරණ වෙළඳපොළෙහි පවතින දැඩි තරඟකාරීත්වය තුළ, වෙළඳපොළ කොටස පවත්වාගැනීම සඳහා සන්නාම පක්ෂපාතීත්වය වර්ධනය කරගැනීම ඉතාම වැදගත් වේ. මෙම අධ්‍යයනයේ අරමුණ ශ්‍රී ලංකාවේ ඉලෙක්ට්‍රොනික ගෘහ විදුලි උපකරණ වෙළඳපොළෙහි වර්ධනයට බලපෑම් කරන සන්නාම පක්ෂපාතීත්වය සඳහා පාරිභෝගික තෘප්තියෙහි වැදගත්කම පරීක්ෂාකිරීම වේ. මෙම ප්‍රධාන අරමුණට බලපෑම් කරන උප අරමුණු දෙකක් ලෙස සන්නාම විශ්වාසය සහ සන්නාම ප්‍රතිරූපය පාරිභෝගික තෘප්තිය කෙරෙහි සිදු කරන බලපෑම හදුනාගන්නා ලදී. මෙම ක්ෂේත්‍රයට අදාලව සිදු කරන ලද පෙර පර්යේෂණ හා වාර්තාවන් අනුව නිරීක්ෂණයවුයේ ලෝකයේ බොහෝ රටවල මීට අදාලව පර්යේෂකයන් පර්යේෂණ රාශීයක් සිදු කර ඇතත් ශ්‍රී ලංකාව තුල එසේ නොමැති බවයි. එබැවින් ශ්‍රී ලාංකික සංදර්භය තුල ඇති වී තිබෙන එම රික්තකය පිරවීම සඳහා මෙම පර්යේෂණයෙන් ප්‍රයත්න දරයි. මෙහි දී පරායත්ත විචල්‍ය වශයෙන් සන්නාම පක්ෂපාතීත්වය සහ ස්වායක්ත විචල්‍ය වශයෙන් සන්නාම ප්‍රතිරූපය හා සන්නාම විශ්වාසය හදුනාගෙන ඇති අතර අනතර් මධ්‍ය විචල්‍ය ලෙස පාරිභෝගික තෘප්තිය හදුනාගන්නා ලදී. මෙහි දී දත්ත රැස් කිරීම සඳහා දම්රෝ ආයතනයේ මාතර දිස්ත්‍රික්කයේ පාරිභෝගිකයන් 175 ක් නියැදිය ලෙස යොදාගන්නා ලදී. මෙහිදී Google form, questionnaire යොදාගනිමින් දත්ත රැස් කරන ලදී. දත්ත විශ්ලේෂණය කිරීමට ප්‍රතිගාමී විශ්ලේෂණ ක්‍රමය (Regression method) භාවිතා කරන ලදී. එසේම මෙහිදී ජනවිද්‍යාත්මක දත්ත හා පසුබිම් දත්ත පරීක්ෂා කිරීමට විස්තරාත්මක සංඛ්‍යානය ද විචල්‍යයන් කෙරෙහි ඇති කරන බලපෑම හදුනාගැනීම සඳහා ප්‍රතිපායන විශ්ලේෂණය සහ ගොඩනගන ලද උපකල්පන පරීක්ෂා කිරීමට ප්‍රතිගාමී විශ්ලේෂණ ක්‍රමය ද භාවිතා කරන ලදී. මෙහිදී දායකත්වය සාක්ෂි මගින් සනාථකිරීම, අධ්‍යයන පරාමිතීන් පැහැදිලි කිරීම සහ ප්‍රතිඵල සාමාන්‍යකරණය වීම වැලැක්වීම සඳහා සීමාවන් සැලකිල්ලටගෙන ඇත. මෙම පර්යේෂණය මගින් සන්නාම පක්ෂපාතීත්වය සඳහා පාරිභෝගික තෘප්තිය ධනාත්මක බලපෑමක් ඇති කරන බව තහවුරු කරයි. එසේම පාරිභෝගික තෘප්තිය ඇති වීමට සන්නාම විශ්වාසය හා සන්නාම ප්‍රතිරූපය බලපාන බවත් තහවුරු කර ඇත. මෙම අධ්‍යයනයේ ප්‍රධාන සීමාවන් ලෙස, පාරිභෝගික තෘප්තියෙහි ස්වභාවය මානව සම්පත හා බැඳී ඇති පුද්ගලානුබද්ධව එකිනෙකට වෙනස්වන සාධකයක් වන අතර එය පැහැදිලිව ගණනය කර දැක්වීම අපහසු වීම, අධ්‍යයනය ශ්‍රී ලංකාව තුල සිදු කිරීමේ දී එක් දිස්ත්‍රික්කයක් පමණක් තෝරා ගැනීම, ඉතා විශාල පාරිභෝගික ප්‍රජාවක් අතරින් 175 නියැදියක් පමණක් භාවිතා කිරීම පැවතිනි.

Keywords: *සන්නාම පක්ෂපාතීත්වය (Brand Loyalty), සන්නාම විශ්වාසය (Brand Trust), සන්නාම ප්‍රතිරූපය (Brand Image), පාරිභෝගික තෘප්තිය (Customer Satisfaction)*
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A Study of the Relationship between English Literacy and Academic Literacy among Undergraduates in Faculty of Humanities and Social Sciences, University of Ruhuna, Sri Lanka

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Abstract

The economy of the country rewards from education. When it comes to producing arguments about one's own and the nation's future, education is a very cruicial matter. Scholars around the world are keen to undertake researches in the field of academic achievement. Limited research has specifically addressed the relationship between English language literacy and academic literacy among students in Sri Lankan higher education institutions, particularly in the context of the Faculty of Humanities and Social Sciences. This study focused to address this gap by examining the interplay between English language proficiency and academic literacy within Social Sciencs academic setting using mix method approach. In order to examine the relationship the between academic literacy and English language literacy between students in the Faculty of Humanities and Social Sciences, this study employed a mixed approach which combined quantitative surveys and qualitative studies. The students in the faculty were given a questionnaire to assess their reading, writing, speaking, and phonemic awareness of the English language and their academic performance in the during a semester. The questionnaire was assembled with closed-ended and open-ended questions. The results of the Pearson's product moment movement correlation test indicated a moderate positive relationship between English language proficiency and academic proficiency among students. The findings of the study proved that there was a need to improve students speaking and writing ability in English. On the other hand, the usage of English was very poor. English is an ideal component of a perfect graduate. So, it is an important point to revise the attention again in to practical aspects of English teaching and learning process with special reference to faculty of Humanities and social sciences in University of Ruhuna.

Keywords: *Academic literacy, Arts undergraduates, English literacy, Mix method, State Universities Sri Lanka*

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Demographic Factors Associated with Depressive Symptomatology among Non-academic Staff Members in a Southern University in Sri Lanka

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Abstract

New challenges in higher education such as greater student intake, limited resources and stakeholder demands have put extra pressure on both academic and non-academic staff, and such pressure may result in developing fatigue and depression in them. The objective of the study was to investigate demographic characteristics associated with depressive symptoms in a sample of non-academic staff members in a Southern university in Sri Lanka. A cross-sectional survey design was used. Data was collected using Google forms and ethical clearance was obtained from the Ethics Committee of the Faculty of Allied Health Sciences, University of Ruhuna, Galle. The Center for Epidemiologic Studies- Depression scale (CES-D-10), a tool validated in Sri Lanka was employed to assess depressive symptomatology of the participants. The score of the CES-D 10 ranges from 0 to 30, with higher scores representing a more depressed mood. Score equal or above 10 is considered as having depressive symptoms. A total of 310 non-academic staff members participated in the survey. The majority were men (57%) and the mean age was 43 years (SD = 9.4). The mean number of years that the participants worked was 18 years (SD = 9.9). The overall prevalence of elevated depressive symptomatology was 56.3% (95% CI: 49.7%, 62.6%). Female gender (OR = 6.01, 95% CI: 3.28 10.97), having completed tertiary education (OR = 44.6, 95% CI: 10.57, 188.1) and having less than 10 years of work experience (OR = 3.20, 95% CI: 1.79, 5.71) were found to be factors associated with higher risk of developing Depressive symptoms. The prevalence of depressive symptoms is considerably high in this target population. Authorities need to pay special attention to improve psychological well-being of female non-academic staff members. Structural and personal factors associated with associated with psychological well-being of non-academic staff members needs to be further investigated.

Keywords: *Depressive symptomatology, Non-academic staff, Sri Lanka, University*

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උඩරට නර්තන සම්ප්‍රදායේ කලඑළි මංගල්‍යයට එකතු වූ නවාංග පිළිබඳ විමර්ශනාත්මක අධ්‍යයනයක්

ජේ.කේ.ද. සිල්වා*, එස්.එම්.ඒ.පී. රත්නසිරි

ඉතිහාසය හා පුරාවිද්‍යා අධ්‍යයනාංශය, රුහුණ විශ්වවිද්‍යාලය, ශ්‍රී ලංකාව

සාරසංක්ෂේපය

ශ්‍රී ලංකේය සංස්කෘතියේ විචිත්‍රත්වයට නර්තන කලාවෙන් සාධාරණ දායකත්වයක් ලැබේ. අස්පර්ශනීය සංස්කෘතික උරුම යටතට ගැනෙන නර්තන කලාව උඩරට, පහතරට, සබරගමු, වශයෙන් ත්‍රිත්ව සම්ප්‍රදායන් ඔස්සේ විහිදී යයි. මහනුවර, උඩුදුම්බර, හේවාහැට ආදී උඩරට ප්‍රදේශවල ව්‍යාප්තව පවතී. උඩරට සම්ප්‍රදායේ නර්තන ශිල්පියා ප්‍රථම වරට නැකැත් චාරිත්‍රානුකූලව හිස වෙස් පැළඳීම කලඑළි බැසීම ලෙසින් හඳුන්වයි. මෙම සම්ප්‍රදායේ චාරිත්‍ර විධි පිළිබඳව පර්යේෂණ සිදු කර ඇතත් කලඑළි බැසීමේදී එකතු වූ නවාංග පිළිබඳව ප්‍රාමාණික පර්යේෂණ සිදු කර නොමැති අතර එය පර්යේෂණ හිඩැසකි. උඩරට නර්තන සම්ප්‍රදායේ කළ එළි මංගල්‍යයට එකතු වූ නවාංග මොනවාද? යන අධ්‍යයන ගැටලුව විමර්ශනය කිරීමට මෙමගින් උත්සාහ ගෙන ඇත. මෙලෙස උඩරට නර්තන සම්ප්‍රදායේ කළ එළි මංගල්‍යයට එකතු වූ නවාංග ගවේෂණය කිරීම, එය කළ එළි මංගල්‍යයේ පාරම්පරික චාරිත්‍රවලට සිදු කළ බලපෑම විමර්ශනය කිරීම හා ඒවා විවල්‍යතාවයන්ට පත්වන අයුරු ගවේෂණය කිරීම මෙහි අධ්‍යයන අරමුණු ලෙස පෙන්වා දිය හැකිය. මෙම පර්යේෂණය ගුණාත්මක පර්යේෂණ ක්‍රමවේදය මත පදනම්ව සිදු කරන ලදී. ඒ සඳහා පුස්තකාල අධ්‍යයන ක්‍රමය හා ක්ෂේත්‍ර අධ්‍යයන ක්‍රමය යන පර්යේෂණ ක්‍රමයන් භාවිත කරන ලදී. ලබාගත් ප්‍රාථමික හා ද්විතියික දත්ත ගුණාත්මකව විවරණය කරමින් තේමාත්මක හා කථනාත්මක යන විශ්ලේෂණ ක්‍රම භාවිතයෙන් අවසන් නිගමනවලට පැමිණ ඇත. කළ එළි මංගල්‍යයට එකතු වූ නවාංග ලෙස සිලම්බු මංගල්‍යය, කලස් පේ කිරීම, තොට පේ කිරීම ආදිය දක්වාලිය හැකිය. මෙම නවාංග තුළින් පැවති ඇතැම් පාරම්පරික චාරිත්‍ර ක්‍රමවේදය යම් විවල්‍යතාවයකට පත් වීමට බලපෑම් සිදුකර ඇති බවත්, මේ තුළින් කළ එළි මංගල්‍යය තුළ නව චාරිත්‍ර සමූහයක් එල්බ ගෙන ඇති බව ද නිගමනය කළ හැකි අතර ම ඇතැම් චාරිත්‍ර බණ්ඩනය වීමට ද මෙය බලපෑම් කොට ඇති බව නිගමනය කළ හැකිය. මෙම පාරම්පරික ඥානය සංරක්ෂණය කිරීම, නිවැරදි චාරිත්‍ර නවක නර්තන ශිල්පීන්ගේ අවධානයට නතු කිරීම යොජනා ලෙස ඉදිරිපත් කළ හැකිය.

ප්‍රමුඛ පද: *උඩරට නර්තන සම්ප්‍රදාය, කළ එළි මංගල්‍යය, චාරිත්‍ර, නවාංග*

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ශ්‍රී ලංකාවේ මල්වර චාරිත්‍ර පිළිබඳ විමර්ශනාත්මක අධ්‍යයනයක් (මාලබේ ප්‍රාදේශීය ලේකම් කොට්ඨාසයේ වැලිවිට ග්‍රාමය ඇසුරින්)

එල්.එල්.එල්. මධුවන්ති, එල්. ගමගේ*

ඉතිහාසය හා පුරාවිද්‍යා අධ්‍යනාංශය, රුහුණ විශ්වවිද්‍යාලය, ශ්‍රී ලංකාව

සාරසංක්ෂේපය

අස්පර්ශනීය උරුමයක් ලෙස සැලකෙන මල්වර චාරිත්‍රය පුරාතනයේ සිට ශ්‍රී ලංකාවේ පැවත එන්නෙකි. දැරිවියක වැඩිවියට පත්වීමේදී පවත්වනු ලබන මෙම චාරිත්‍රය පළාතෙන් පළාතට හා ප්‍රදේශයෙන් ප්‍රදේශයට මෙන්ම එකම ප්‍රදේශයක වුවද විවිධ විශ්වාසයන් අනුව වෙනස්කම් හඳුනාගත හැකිය. මෙම චාරිත්‍ර චාරිත්‍ර සාමූහික සහභාගීත්වය යටතේ සිදු කෙරෙන නිසා පුද්ගලයන් අතර අන්‍යෝන්‍යය බැඳීම් ඇති කරන අතර සාමූහික සංස්කෘතික අනන්‍යතා ශක්තිමත් කරමින් ප්‍රජාවක සමාජ ඒකාබද්ධතාව සහ සමාජ සන්දර්භය ශක්තිමත් කරයි. මල්වර චාරිත්‍ර හා සම්බන්ධ වර්යා සම්මතයන් ඔස්සේ රටක බාල පරම්පරාවට තමන් ජීවත්වන සමාජ සන්දර්භය තුළ ඔවුන්ගේ භූමිකාව, වගකීම් හා බැඳීම් පිළිබඳ අවබෝධය වර්ධනය කර ගැනීමට අවස්ථාව ලැබේ. මල්වල චාරිත්‍ර සංකේත හා සංකේතාත්මක ක්‍රියාවලියන්ගෙන් පොහොසත් අස්පර්ශීය උරුමයකි. මෙම අධ්‍යයනයේ මූලික අරමුණ වන්නේ ශ්‍රී ලංකාවේ බස්නාහිර පළාතේ, කොළඹ දිස්ත්‍රික්කයේ පවතින මල්වර චාරිත්‍රවල සුවිශේෂතා හඳුනා ගැනීමයි. එහිදී අධ්‍යයන ප්‍රදේශය වශයෙන් මාලබේ ප්‍රාදේශීය ලේකම් කොට්ඨාසයේ (475/A), වැලිවිට ග්‍රාමය තෝරා ගැනුණි. මෙම ප්‍රදේශයේ එකිනෙකට වෙනස් සංස්කෘතීන් නියෝජනය කරන බෞද්ධ, කතෝලික, මුස්ලිම් යන බැතිමතුන් තුන් වර්ගයම ජීවත් වෙති. මේ අනුව මෙම ප්‍රදේශය තෝරාගනු ලැබුවේ විවිධ සංස්කෘතීන් පදනම් කරගෙන විවිධත්වයෙන් යුතු දත්ත එක්රැස් කර ගැනීමේ අපේක්ෂාවෙනි.මෙම පර්යේෂණය ගුණාත්මක දත්ත විශ්ලේෂණයකි. ප්‍රාථමික හා ද්විතීය මූලාශ්‍ර යන දෙවර්ගයම භාවිතයට ගැනුණි. ද්විතීය මූලාශ්‍ර අතර විවිධ විද්‍යාර්ථීන් රචනා කරන ලද පර්යේෂණ පත්‍රිකා හා ග්‍රන්ථයන් සඳහා සුවිශේෂී ස්ථානයක් හිමිවේ. ප්‍රාථමික දත්ත ක්ෂේත්‍ර පර්යේෂණය ඔස්සේ එක්රැස් කරගනු ලැබිණි. වැලිවිට ග්‍රාමයේ ජීවත්වන බෞද්ධ, කතෝලික හා මුස්ලිම් යන සමාජ කොට්ඨාසවල ජන අනුපාතයට සාපේක්ෂව පුද්ගලයන් තිස් දෙදෙනෙක් සමග ගැඹුරු සාකච්ඡා (In-depth interviews) සිදු කරනු ලැබුණි. සම්මුඛ සාකච්ඡා සඳහා යොදාගත් ප්‍රශ්න තේමාවට අදාලව පෙර සැලසුම් කරන ලද (Semi-structured) ඒවාය. ඒවාගේම ඉලක්කගත කණ්ඩායම් සාකච්ඡා ක්‍රමය භාවිතා කරනු ලැබුණි. එක්රැස් කරගත් දත්ත තේමාත්මක විශ්ලේෂණ ක්‍රමය (Thematic analysis method) ඔස්සේ විශ්ලේෂණය කරනු ලැබුණි. බෞද්ධ, කතෝලික හා මුස්ලිම් යන බැතිමතුන් ත්‍රිත්වයම මෙහි වාසය කරන අතර ඔවුන් එකිනෙකා අතර තම සංස්කෘතියට අනන්‍ය චාරිත්‍ර ක්‍රියාත්මක වන අතර සමහර අවස්ථාවල ඒකී චාරිත්‍රවල සම්මිශ්‍රණයක්ද විද්‍යමාන වේ.

ප්‍රමුඛ පද: *අස්පර්ශීය උරුමය, ඓතිහාසික, කොළඹ, මල්වර චාරිත්‍ර, වැලිවිට ග්‍රාමය*

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Empowering Undergraduates in Integrating Life Skills Education into Tertiary Curricula: A Case Study

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Abstract

Life skills education is a tool that equips undergraduates to make informed decisions, communicate effectively, and deal with personal, social, and professional challenges and demands. It empowers undergraduates and prepares them for real-life challenges. Incorporating life skills education into the tertiary curricula allows undergraduates to clarify issues, understand their rights, and develop self-confidence, courage, and responsibility in relationships and in society. This integration, however, remains sporadic and inconsistent. Therefore, the present study focused on integrating life skills education in the curricula of the higher educational institutions within the context of the Sri Lankan higher education system and highlighted related challenges, available opportunities, and strategic ways forward. Through a qualitative case study approach, this research aimed to explore stakeholder perspectives and the content of curricula at a selected university in Sri Lanka, attempting to suggest an applicable framework for integrating life skills education. Semi-structured interviews with university lecturers and curriculum developers were conducted in order to identify challenges and strategies related to integration. Focus group discussions were held with undergraduates to understand their views, experiences, and expectations related to life skills education, with each group comprising 6–8 students. In addition, a review of relevant existing curricula, syllabi, and institutional policies was undertaken in order to further assess the current status of life skills education. Its results highlighted a significant lack in terms of the embedding of life skills within tertiary curricula. Both university educators and students recognised the significance of education in life skills; however, they also noted various obstacles, such as constrained resources, time limitations, a deficiency in understanding, and inadequate prioritisation by institutions. Additionally, it was observed that university educators often lack training in pedagogical approaches for life skills, given that their expertise predominantly lies in specific subject areas. The excessive focus on discipline-specific content within current curricula also hinders the incorporation of life skills education.

Keywords: *Higher education, Life skills education, Tertiary curricula, Undergraduates*

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Local Ceramics and Society during the Rajarata Civilization: Case Studies from Kantharodai, Mantai (*Mahatittha*), and Kirinda in Sri Lanka

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Abstract

Ceramics (pottery) were a basic household commodity in all pre-modern societies. Demand for utilitarian and luxury wares increased with the evolution of societies over time. This led to the advancement of technology and the diversification of pottery crafts, and hence, the analysis of pottery is likely to provide insights into the various aspects of societies in the past. A total of 42082 sherds representing 28 different wares recovered from three key historic sites, namely, Kantharodai, Mantai (*Mahatittha)*, and Kirinda that existed during the Rajarata civilisation of Sri Lanka, were analysed using standard methodology published in literature. Local wares were identified based on published material and ethnographic studies. All three assemblages were quantified and described following a slightly modified version of the methods described by Kennet in 2004. The ceramic assemblages from these three sites date from the second to the twelfth/thirteenth centuries CE - the entire length of the Rajarata civilisation. These assemblages illustrate significant variations in potting attributes such as technology, typology, inclusions, and decorations. Crosscutting these variations, however, there are also striking similarities, such as surface treatment and decorations in these assemblages. Therefore, the key research question investigated in this research is: What factors contributed to these similarities and differences found across assemblages over time and space? The analysis of ceramics from these sites illustrates that the dissimilarities observed are likely to have arisen due to the production of ceramics at multiple production sites that lacked standard technology and differences in potting traditions. Trade and exchange of ceramics and transfer of technology through intermarriages among closely knit blood relations likely contributed to the similarities observed across assemblages. The composition of the ceramic assemblages varied across sites over time, while certain ceramics were preferred across regions. The analysis of local ceramics shed light on aspects of society unknown from historical sources during the Rajarata civilisation.

Keywords: *Ceramics/Pottery analysis, Kantharodai, Kirinda, Mantai, Society during the Rajarata civilization*

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Ethical Perspectives and Strategies for AI Integration: Insights from Allied Health Students at the University of Ruhuna

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Abstract

Artificial intelligence (AI) is revolutionizing academic and professional domains, necessitating an understanding of ethical implications. This study assessed allied health students at the University of Ruhuna, Sri Lanka, regarding their perspectives on AI, focusing on ethical concerns and strategies to address them. A cross-sectional study was conducted in 2024 among 278 undergraduates from the Faculty of Allied Health Sciences, utilizing a pretested, self-administered questionnaire. The most significant ethical concerns identified were data privacy (n = 186, 67.1%), followed by a lack of transparency, accountability, and liability (60.6%), academic integrity (46.6%), algorithmic bias (38.3%), and psychological impact (35.4%). However, concerns about job displacement were less significant (27.1%). Students suggested several strategies to enhance ethical awareness. The most favoured approach (44.7%) was integrating ethics-focused courses or modules into academic curricula. Encouraging open discussions on AI ethics (25.65%) and supporting research projects focused on ethical issues (19.1%) were also highlighted. Collaboration with industry partners, though less frequently recommended (10.6%), was recognized as a potential avenue for fostering awareness. Students also recognized their roles in shaping AI's ethical use. Most (87.7%) emphasized the importance of participating in discussions on AI ethics and offering constructive feedback to influence policy. Advocating for transparency in AI systems (39.7%) and conducting research on AI ethics (35.0%) were viewed as critical. Collaborating with faculty and administrators (27.4%) and creating student-led initiatives like student societies (17.3%) were additional measures identified to promote a culture of ethical responsibility. The findings emphasize the urgency of addressing ethical concerns associated with AI in academic settings. Integrating ethics into education and fostering collaboration can prepare allied health students for the ethical challenges posed by AI's growing role in healthcare and academic work.

Keywords: *Artificial intelligence, Allied Health Sciences, Nursing, Sri Lanka*

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Modernization and Its Impact on Reproductive Health: A Study on Women in the Estate Sector in Sri Lanka

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Abstract

Modernization has brought new healthcare, education, and media exposure to rural and Estate populations, causing major socioeconomic changes in Sri Lanka in recent decades. However, taboos and conventional cultural standards continue to have a significant impact on reproductive health practices in some regions. This research explores how Estate Tamil women reconcile traditional cultural beliefs with modern reproductive health care offerings. It investigates how traditional views and customs around puberty and childbearing have been affected by modernization. Furthermore, this study examines how cultural norms facilitate or hinder health-seeking behaviours and the obstacles women encounter when accessing healthcare. Using a qualitative research approach, the study focused on 30 families in selected estates in the Southern Province. Interviews with women and key informants revealed that, despite early marriages, there is awareness of family planning methods. New technology has played a role in updating knowledge about family planning among young people, yet traditional practices persist during puberty. Furthermore, the underutilization of health services is linked to gendered power relations, with women prioritizing work and domestic responsibilities over their health. The results indicate that cultural identification, financial restrictions, social pressures, and psychological comfort with established practices all contribute to the maintenance of conventional reproductive health behaviours. The study identifies ways to support community-based interventions that respect traditional customs while providing access to modern healthcare and education, potentially leading to improved reproductive health outcomes.

Keywords: *Cultural practices, Estate women, Gender, Modernization, Reproductive health*

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Exploring Undergraduate Library Usage and Resource Search Behaviour: A Case Study at the University of Ruhuna Library

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Abstract

The University of Ruhuna Library system consists of a Main Library at the Wellamadama campus, which serves four faculties, and five other faculty libraries catering to specific disciplines. The study sought to identify the University of Ruhuna undergraduates' library use reasons and use frequency compared to the Internet use, and how they search for library resources, which have received little or no attention in the literature. The problem has been studied using a scoping survey distributed online. Referring to Krejcie and Morgan's table, a faculty-wise stratified random sample was used to select undergraduates of University of Ruhuna registered at the library system. Data collected from the completed 236 Google forms were downloaded to a Microsoft Excel spreadsheet for analysis. Findings revealed that the undergraduates use the library for borrowing and returning of books (148, 63%), reading subject books (165, 70%), preparing for the examination (154, 65%), and reading past exam papers (134, 57%). Findings about how they search information revealed that undergraduate students in each faculty had more interest in the Internet use than the library use; while 99 (42%) undergraduates accessed the internet information resources daily, only 24 (10%) and 7 (3%) undergraduates mentioned that they daily used the library and the library web respectively. However, a higher number of undergraduates mentioned that they come to the library weekly (80, 34%). The findings further revealed that searching the shelves (135, 57%) was more popular than taking library staff support for finding their information needs (99, 42%) or using library catalogue (80, 34%) among the undergraduates. Based on the findings, the study recommends marketing programmes introducing library print resources and online resources, and user education to increase their awareness of the library catalogue and the library web.

Keywords: *Information search behaviour, Library usage, University of Ruhuna library*

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මනුෂ්‍ය විඥානය එසවීම, ගැඹුරු කිරීම සහ නවකතාව: පශ්චාත් නූතනවාදී අධ්‍යයනයක්

එන්. වීරසිංහ, අයි.ආර්.එන්.එස්. පීරිස්*

සිංහල අධ්‍යයනාංශය, මානවශාස්ත්‍ර සහ සමාජීය විද්‍යා පීඨය, රුහුණ විශ්වවිද්‍යාලය, ශ්‍රී ලංකාව

සාරසංක්ෂේපය

සංස්කෘතියේ එක් අනුශාංගයක් වන සාහිත්‍යය සංස්කෘතිය මගින් අපේක්ෂිත සංස්කෘතිකකරණයෙහි නිරත වෙයි. සංස්කෘතිය මිනිස් සිතිවිලි සමග ගනුදෙනු කරමින් මිනිසාගේ ප්‍රකෘති ස්වරූපය සංස්කරණය කිරීමේදී දර්ශනවාදය තරම් ගැඹුරට ඔවුන්ව ගෙන යාමටත්, කලාව තරම් උසස් මට්ටමක තැබීමටත් මග පෙන්වයි. එම ශක්‍යතාව නවකතාව සතුය. සංස්කෘතියේ කාර්යභාරයක් වන පුද්ගල විඥානය එසවීම සහ ගැඹුරු කිරීම යන සංකල්පය ඇල්ෆ්‍රඩ් නෝර්ත් වයිට්හෙඩ්ගේ The Aims of Education කෘතියෙහි අන්තර්ගත වූවකි. ජීවිතය සහ සමාජය අර්ථකථනය කිරීමට අවශ්‍ය අවබෝධය ඇති කිරීම පුද්ගල විඥානය එසවීමයි. පොදු සමාජයේ පුද්ගල මනෝභාව සහ සංසිද්ධිවල හේතු ප්‍රත්‍යාදී අභ්‍යන්තරය ප්‍රශ්න කිරීම පුද්ගල විඥානය ගැඹුරු කිරීමයි. නවකතාවෙන් පාඨකයා ඥානනය කිරීම එසවීම සහ ගැඹුරු කිරීම වශයෙන් අධ්‍යයනයේදී අර්ථ දක්වයි. පශ්චාත් නූතන සමාජයේ පුද්ගල විඥානය එසවීම සහ ගැඹුරු කිරීම ප්‍රේමානිශංස නවකතාවෙන් සිදු කරන්නේ කෙසේද යන පර්යේෂණ ගැටලුව ගුණාත්මක පර්යේෂණ ක්‍රමවේදය යටතේ සාහිත්‍ය විමර්ශන විධික්‍රමය මගින් අධ්‍යයනය කෙරිණි. පශ්චාත් නූතනවාදී න්‍යාය ඇසුරින් නවකතාවේ අනුභූතිය, චරිත හා සිද්ධි නිරූපණය යන ත්‍රිත්වය ඔස්සේ සාපේක්ෂතාව, සංස්කෘතික සම්මිශ්‍රණය, ගෝලීයකරණයේ බලපෑම සහ මානව සංස්කෘතියෙහි ප්‍රගමනය සහ ඓතිහාසික විකාසනය කෙරෙහි අවධානය යොමු කෙරිණි. එහිදී, සමාජය සහ ජීවිතය පිළිබඳ නොගැඹුරු චින්තනයක් දැරීම මනුෂ්‍යත්වය කෙරෙහි අපක්ෂපාතී දෘෂ්ටියකට උපස්තම්භක නොවන බවත්, මනුෂ්‍යත්වය වගා කිරීමට සාහිත්‍යයෙන් අපේක්ෂිත පෙලඹවීම නවකතාව මගින් සිදු කරන බවත් හෙළි විය. ප්‍රේමානිශංස නවකතාව පුද්ගල සංවර්ධනය සඳහා ඒක පුද්ගල සහ සමාජීය මාර්ගෝපදේශනයක් සිදු කරන්නේ වයිට් හෙඩ් දක්වන මිනිසා හඳුනා ගැනීම, නාමකරණය, ප්‍රතිචාර දැක්වීම සහ දෛනික සංසිද්ධි අර්ථකථනය කර ගැනීමේදී පුළුල් දෘෂ්ටිමය ශික්ෂණයක් ඇති කිරීමට අවශ්‍ය චරිත නිරූපණය නිරූ-සයුරු-සහ දෙපාර්ශ්වයේ දෙමව්පියන් ප්‍රධානව නිරූපණය කරමිනි. පුද්ගලයා ඉතිහාසයෙන් පාඩම් උගෙන සමාජ සංවර්ධනයේ ඓතිහාසික දියුණුවක් ළඟා කර ගන්නා බව සිංහල රදල සහ ද්‍රවිඩ කුමාරස්වාමි පරම්පරා ඇසුරින් විග්‍රහ කරයි. චින්තනය, නිදහස, ගතිකත්වය පිළිබඳ අදහස් යාවත්කාලීන කරවන අර්ථවත් අන්තර්ගතයක් පාඨකයා වෙත යොමු කර ඇත. මනුෂ්‍ය විඥානය ඔසවා තබමින්, ගැඹුරු කරමින් වඩා සාර්ථක ජීවිතයක් වෙනුවෙන් ශික්ෂණය කරවීම එයින් සිදු වෙයි. ජාතියක් මෙහෙය වීමට නවකතාව සතු සමාජ සංසිද්ධි සහ චරිත විනිවිද යෑමේ සහ පෙලඹවීමේ ශක්තියත්, වාග් විලාසය සහ උචිත අනුභූති සම්පාදනයත් පුද්ගල විඥානය එසවීම සහ ගැඹුරු කිරීමට උපකෘත වී ඇති බව අධ්‍යයනයෙන් අනාවරිතය.

Keywords: *එසවීම, ගැඹුරු කිරීම, චින්තන ශෛලිය, නිදහස*

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The Effect of Stitch Length on Sound Absorption Behaviour of Cone Knitted Structures

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Abstract

Acoustic materials play a crucial role in controlling sound in various environments, from industrial spaces to residential and public buildings. As concerns over noise pollution and the demand for energy-efficient, sound-controlling materials rise, there is growing interest in developing materials that offer superior sound absorption properties. Though textile structures are more popular for sound absorption applications, analysis of acoustic properties of 3D knitted structures is not substantiated by much research. 3D knitted fabrics offer distinct advantages due to their increased surface area, which enhances sound wave interaction and absorption. Their unique geometry and customizable parameters enable precise control over their physical properties, including porosity, surface area, and density. These features allow for enhanced interaction with sound waves, improving their absorption performance across different frequencies. Therefore, this study investigates the effect of stitch length on sound absorption behavior of cone knitted structures using the reverberation room method. Four samples with stitch lengths of 3.72 mm, 3.04 mm, 2.61 mm, and 2.08 mm were prepared using a flatbed knitting machine and tested according to the ASTM C423 standard. This range of stitch lengths was selected by adjusting the cam settings to prevent yarn or fabric damage. Reverberation time measurements across frequencies from 200 Hz to 10,000 Hz were conducted and sound absorption coefficients were derived using Sabine's formula. Results indicate that shorter stitch lengths, associated with higher stitch and surface densities, enhance sound absorption, particularly at higher frequencies. These findings suggest that 3D knitted cone fabrics are effective in sound absorption, with potential applications in building acoustics and noise control. Optimizing fabric geometry and structural parameters can enable the development of versatile and efficient acoustic materials, contributing to sustainable solutions for noise pollution and energy-efficient building design.

Keywords: *Acoustic, Knitted, Noise, Reverberation, Stich-length*

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Design and Development of a Cost-effective Natural Sunlight Mimicking Smart LED Lamp for Domestic Aquatic Environments

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Abstract

One of the main factors affecting the health of a natural aquatic environment is exposure to sunlight during the daytime. Therefore, in domestic aquariums, providing lighting that simulates sunlight with natural intensity variation is highly beneficial. This study focuses on developing a smart LED lamp capable of simulating the intensity variation of natural sunlight. A cost-effective light intensity sensor (BH1750) was used to collect data on the natural intensity variation of sunlight, and the accuracy of its readings was verified using a PASCO high-sensitivity light sensor, which is limited to 100 lux. The BH1750 sensor showed excellent agreement with the PASCO sensor, with an R-squared value of 0.9997, indicating a near-perfect correlation in light intensity measurements. After analyzing the variation in natural sunlight intensity throughout the day over a period of more than two months, a pattern for the average light intensity was developed to simulate a typical day's progress. An ESP32-WROOM-32 board was used to control the 240 addressable RGB LEDs of the lamp, which can collectively produce a maximum luminosity of 4800 lumens. The lamp was able to simulate the natural sunlight intensity pattern, with peak wavelengths for the red, green, and blue LEDs ranging from 620 - 630, 515 - 530, and 465 - 475 nm, respectively. These RGB LEDs are commonly used for artificial lighting in the aquarium industry worldwide. The Wi-Fi and Bluetooth capabilities of the ESP32 microcontroller were used to control the lamp via mobile devices, making it more user-friendly. This smart LED lamp, which mimics the intensity variation of natural sunlight, has the potential to help maintain conditions similar to natural aquatic environments in domestic aquariums and may also be used to reduce unwanted algae growth by controlling light intensity.

Keywords: *Aquarium lighting, ESP32 microcontroller, Light intensity sensor, Smart LED lamp, Sunlight mimicry*

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Optimization of Waste Casting Sand in Cement Brick Manufacturing: A Comparative Analysis of Compressive Strength and Washout Percentage

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Abstract

This research studies the possibility of recycling Waste Casting Sand (WCS) as a substitute for natural sand in cement brick manufacturing. WCS is a major byproduct of metal casting that loses its usefulness with time. As environmental and economic benefits due to WCS usage, enabling a reduction in the dependency on natural sand, minimization of waste disposal problems, and promotion of sustainable construction. Four brick methods (WCS proportions 0%, 60%, 80%, and 100%) were studied. Method 1 is a control mix with no WCS (conventional cement brick), Method 2 is 60% WCS and 40% natural sand, Method 3 is 80% WCS and 20% natural sand, and Method 4 is 100% WCS. A common mix proportion that is used in cement brick manufacture is mostly 1 cement (14%), 2 sand (29%), 4 chip stone (57%), and as required water. Compressive strength (N/mm²) and washout percentage (4 bricks each from one method), which are key indicators of the durability of bricks, were evaluated as major parameters. Results showed that 60% WCS bricks (Method 2) gave the greatest compressive strength (6.31 N/mm²), with better performance compared to the conventional brick (3.11 N/mm²). Method 3 (80% WCS) and Method 4 (100% WCS) gave 5.17 N/mm² and 4.94 N/mm², respectively. Increased WCS content, however, increased the percentages of washout, with Method 4 being at 0.029% (± 0.007) while Methods 1, 2, and 3 gave 0.008% (± 0.001), 0.007% (± 0.001), and 0.009% (± 0.004), respectively (ANOVA test). Particularly at 60%, enhances compressive strength with acceptable durability. Methods 3 and 4 also exhibited better strength than conventional bricks, and all three methods had an insignificant environmental impact due to the percentage of washout. The findings suggest a range of sustainable production of bricks using WCS replacement of 60% - 100% and provide a sustainable solution for reducing industrial waste while conserving natural resources in brick manufacturing.

Keywords: *Cement bricks, Compressive strength, Percentage of washout, Waste casting sand*

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Development of a Semi-automatic, Portable Coconut De-husking Machine

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Abstract

Coconut de-husking is a critical yet challenging process in the coconut industry of Sri Lanka, particularly for small scale farmers. In Sri Lanka, traditional methods are widely used but are labour-intensive, inefficient and physically demanding. Existing machine-assisted alternatives often remain costly, complex and unsuitable for small-scale users and huskers. To overcome these limitations, semi-automatic, portable coconut de-husking machine was designed targeting small scale farmers and huskers in Sri Lanka. The machine incorporates a three-arm blade mechanism powered by a linear actuator. The loading and unloading are done manually. The blades penetrate the husk and apply force to split it away from the nut. The mechanism is designed to ensure minimal damage to the nut during the de-husking process. It is fabricated using locally sourced, standard materials. The design is compact to enhance portability because most huskers move from one farm to another to de-husk coconuts. The machine is 1.8 meters in height and weights around 25 kg. With removable support brackets, the machine ensures simple transportation and portability between locations, while allowing for simple assembly and disassembly. Performance tests demonstrated that the machine can process varieties of coconuts and it took 1 minute to de-husk a coconut. This machine offers an efficient, affordable and portable solution for small-scale coconut farmers, improving de-husking productivity and reducing reliance on labour-intensive methods.

Keywords: *Coconut de-husking machine, Coconut processing, Efficiency, Ergonomic design, Husker, Semi-automatic, Portable, Small-scale farmers*

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Blockchain-based Spectrum Leasing for Efficient Utilization of Unused Spectrum

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Abstract

In this technically advanced era, the Internet of Things and Machine-type Communication are becoming more important as the requirement for the wireless spectrum is increasing to unseen levels. Current spectrum management tactics are not providing the desired push to such demand, leading to inefficient utilization of spectrum resources. It is important to note that licensed spectrum bands have certain unused spectrum bands known as “spectrum holes” or “white holes” which could be varied in duration from milliseconds to weeks. To address this inefficiency, this paper describes a blockchain-based solution to develop a decentralized, efficient, and trustworthy platform for leasing spectrum resources, specifically using the Ethereum platform. Based on the Ethereum platform, the proposed system ensures transparency and trust among participants and eliminates the intermediaries' involvement. In contrast with existing blockchain-based spectrum management models, we introduce a dual-mode auction system in which open and closed bids can be performed with enough freedom in two rounds, namely bidding and bid-revealing rounds. In addition to improving the substantive aspects of the platform, a micropayment scheme is integrated to reduce the transaction costs of the spectrum leasing process. The notifications related to payments are integrated into a real-time, notification event-driven system to keep participants aware of the payment status with a seamless experience. The proposed system also features a user-friendly decentralized application that can facilitate easy access and interaction with the marketplace. Thus, this unique trading platform assists in developing a seamless, secure, and transparent spectrum leasing framework. The proposed platform effectively deals with the problems of the conventional spectrum management approach highlighted in this paper and formulates a clear, protected, and expandable environment for flexible spectrum leasing. Spectrum efficiency is enhanced with this concept, addressing the ever-growing demands of Internet of Things (IoT) and Machine-Type Communications (MTC) technologies, thereby laying the foundation for a sustainable wireless ecosystem.

Keywords: *Blockchain, Decentralized applications, Radio spectrum management, Smart contracts*
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Enhancing Autonomous Vehicle Safety and Efficiency: Development of a Scaled Testbed for Evaluating Multiple ANN Architectures in Autonomous Driving

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Abstract

Modern transportation is facing increasing challenges, such as high rates of accidents due to human error, insufficient reaction time, and decision efficiency of humans, which require improvement in advanced autonomous vehicle (AV) technologies. On this basis, this research aims to develop a small-scale testbed for experimental driving via Artificial Neural Networks (ANN) and Computer Vision, more specifically Convolutional Neural Networks (CNN). Key AV tasks like lane detection, road sign recognition, steering control, and obstacle detection can be controlled during experimentation on a testbed. The processing of data from an on-board camera from the CNN models is used for real-time perception and two decisions, unlike the reinforcement learning-based approaches. Thus, this study objectively evaluates the performance of the ANN models under various driving conditions concerning response time and navigation accuracy. It is shown further how CNN-based techniques can improve the perception and control of AV. This work addresses the cost-effective and scalable platform that bridges the gap between simulation-based research and real-world AV experimentation compared to existing studies. The importance of the findings is in developing safer, more reliable autonomous vehicles and likewise providing a practical framework for further developments in AV technology.

Keywords: *Artificial neural networks, Autonomous vehicles, Computer vision, Convolutional neural networks, Deep learning*

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Unsupervised Approach for Post-processing of Intrusion Detection Alerts

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Abstract

Intrusion Detection Systems (IDS) play a critical role in network security, monitoring and identifying suspicious activities to prevent potential threats. However, the overwhelming volume of alerts and high false-positive rates frequently limit their efficacy, making it difficult for security analysts to manage and evaluate the data effectively. Because of these constraints, new approaches are required to improve warning processing and guarantee efficient intrusion detection. Using pattern mining and clustering approaches, this research suggests a unique unsupervised method for post-processing IDS signals. The suggested approach analyzes huge datasets and finds correlations between alerts to eliminate repetition and highlight important patterns. Using agglomerative clustering and the CHARM algorithm for pattern mining, this method efficiently clusters related alarm patterns, providing security analysts with a unified picture of network intrusions. The methodology employs advanced data pre-processing techniques, including adaptive binning, to ensure meaningful and interpretable results. Integrating these techniques simplifies complex alert data, helping analysts focus on actionable insights rather than sifting through noisy information. The proposed system minimises false positives and enhances the detection of diverse cyber threats, such as DDoS, Brute Force, and Botnet attacks, by organising alerts into well-defined clusters. Evaluations demonstrate that this approach significantly reduces analysts' workload while enhancing intrusion detection accuracy. Comparative analyses show that the proposed method outperforms traditional alert management techniques in efficiency and precision. These findings underline the potential of pattern mining and clustering in improving IDS performance.

Keywords: *Alert processing, Clustering, Intrusion Detection System, Network security, Pattern mining*

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Investigation of Sound Absorption Coefficients of Coir Fibre Mat

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Abstract

With the development of transportation sector, mitigation of the impact of transportation noise becomes major topic and various sound-absorbing materials and technologies have been developed and are widely applied across different modes of transportation. These materials help absorb, dampen, or isolate noise from the environment. The coir fibre mats and composites are identified as effective and eco-friendly sound absorbing materials instead of synthetic sound absorbing materials. This research investigated the sound absorption coefficients of coir fibres mat composed of a matrix and vertically placed core fibre layer with different thicknesses (20 mm and 25 mm). The coir fibre samples are tested in accordance with ISO 10534-2 standards within the frequency range from 63 to 6300 Hz. The PLACID Impedance Tubes with 100 mm and 30 mm diameters are used to observe the data within the whole frequency range. Absorption coefficient data observed for coir fibre mats are compared with the Polyurethane samples of the same thickness of 20 mm. The results depict that the coir fibre mat has good acoustic absorption performance in high frequency range compared to that of the polyurethane sample. The absorption coefficients of both coir fibre mat and the Polyurethane sample are very close at low frequencies. Additionally, two coir fiber mat samples with varying thicknesses were also tested. Approximately 33.33% of improvement in sound absorption is performed with the higher thickness coir fibre composite (25 mm) compared to the lower thickness (20 mm) sample. This study reveals that there is enormous potential to use the natural fibre composites as sound absorbing materials.

Keywords: *Coir fibre composite, Impedance tube method, Sample thickness, Sound absorption coefficient*

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NN-based Puncturing for eMBB-URLLC Coexistence in 5G Wireless Networks

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Abstract

Ultra-reliable low latency communication (URLLC) and enhanced mobile broadband (eMBB) are two of the main service components in 5G wireless networks. While URLLC demand ultra-high reliability and low latency. eMBB require high data rates and spectral efficiency. The coexistence of eMBB and URLLC in the radio frequency resources is challenging due to the trade-off among latency, reliability, and spectral efficiency. Existing mechanisms, such as dynamic resource allocation, puncturing, network slicing, and interference management, often suffer from complexity, inefficiency, and adverse effects on performance of eMBB users. This project proposes a Neural Networks (NN) assessed puncturing mechanism for coexistence of eMBB and URLLC traffic in the downlink where selected eMBB users' resources are punctured with URLLC traffic to fulfill the strict latency requirements of URLLC traffic while minimizing the impact on eMBB users. Herein, a fully connected feedforward NN is utilized for multi-output regression tasks, trained on datasets that reflect initial Block Error Rate (iBLER) and Modulation Coding Scheme (MCS) values of eMBB traffic. Both models predict the optimal eMBB users to puncture, minimizing disruption while meeting URLLC latency requirements. To evaluate performance, four NN architectures were tested. They are Baseline, Deep NN, Dropout NN, and Batch Normalization NN. While Deep NN showed superior accuracy, the Baseline NN was selected for its balanced performance and computational efficiency. Balanced performance avoids overfitting or underfitting, ensuring good generalization to unseen data with acceptable accuracy on training and validation datasets. Additionally, K means clustering mainly used to get an acceptable puncturing position while considering both iBLER and MCS. Experimental results demonstrate that this method effectively accommodates URLLC traffic with minimal eMBB degradation, validating its real-time applicability in dynamic 5G environments. This study lays the groundwork for more adaptive and efficient resource allocation strategies and suggests exploring higher numerologies for enhanced flexibility in future research.

Keywords: *eMBB, Neural networks, Puncturing, Resource Allocation, URLLC*

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Effect of Tyre Derived Aggregates (TDA) on Permeability Behaviour of Railway Ballast

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Abstract

Ballasted railway tracks are the most preferred railway track system in many countries, including Sri Lanka, because of their numerous benefits. Nevertheless, during track operation, ballast degradation and track settlement are major issues that require frequent maintenance. To mitigate these issues, the application of elastic materials such as tyre-derived aggregates (TDA) has gained popularity due to their promising benefits. Mixing TDA with ballast aggregates has been identified as a potential solution to reduce ballast degradation, minimize frequent maintenance requirements, and ultimately improve track performance. However, mixing different size ranges and percentages of TDA with ballast alters the void ratio of the ballast, affecting its permeability characteristics. Hence, the impact of TDA-mixed ballast on the hydraulic conductivity of ballast and track drainage capacity has not been fully understood. Consequently, this study explores the effects of different size ranges and percentages of TDA on the permeability characteristic of railway ballast. To this end, large-scale constant head permeability tests were conducted on TDA-mixed ballast samples using a large-scale permeability test apparatus. In this study, three different TDA size ranges including 3 - 8 mm, 8 - 16 mm, and 19.5 - 26.5 mm and two different percentages (by weight), 10% and 15%, were considered. The experimental results showed that TDA reduced the hydraulic conductivity of ballast by 14% - 88% for the selected TDA size ranges and percentages. Subsequently, a 2D numerical seepage analysis was carried out to evaluate the effect of TDA on the track drainage capacity of a ballasted track. The seepage analysis results indicated that the track drainage condition of the ballast decreased from good drainage to acceptable drainage due to the application of TDA. The findings of this study could be effectively used to guide the careful selection of TDA size ranges and percentages for railway applications.

Keywords: *Permeability, Railway ballast, Track drainage, Tyre derived aggregates*

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The Potential of Green Hydrogen in Achieving Sustainable Energy Future: A Review

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Abstract

There is significant popularity and interest in hydrogen energy from all sectors as one of the promising solutions for a sustainable energy storing method. Hydrogen is the most abundant element in the universe, which is available in many forms. Hydrogen is catagorized by colour codes and it is called green hydrogen when produced through electrolysis using renewable energy sources. These recent developments in green hydrogen have increased attention on aspects such as hydrogen production technologies, hydrogen colour codes, life cycle analysis, and challenges faced. The maritime industry, aviation sector, and transportation industry are some of the major industries that focus on hydrogen energy as an alternative green energy source. Hydrogen production using various renewable energy sources has become a promising way to utilise hydrogen, especially as an electrochemical energy storage medium, which can later be used as a carbon-neutral fuel for various applications. By highlighting the diverse colour codes of hydrogen, weighing both the positive and negative environmental impacts through life cycle analysis on various production technologies, and discussing the critical insights and future implications, this review provides a comprehensive overview of the hydrogen energy landscape. This distinctive approach not only enriches the existing literature but also deepens our understanding of hydrogen's potential as a promising energy source.

Keywords: *Energy storage, Environmental impact, Green hydrogen, Hydrogen colour, Hydrogen production technologies, Renewable energy*

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Two-phase Meshfree-based Numerical Analysis of Coastal Natural Blowhole Structures for Wave Energy Extraction Applications

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Abstract

Ocean structures can be classified as manmade or natural, where manmade structures mainly include offshore oil platforms, offshore wind platforms, and ocean wave energy converters (WECs), etc. and natural structures include blowholes, headland pillars, etc. These structures are often analysed using computational fluid dynamics (CFD) tools to understand wave-structure interactions (WSI) and forces exerted by sea waves. Single-phase hydrodynamic modelling is typically used for such simulations because it simplifies the process and reduces computational time. However, in some cases, two-phase hydrodynamic modelling is essential, especially when air compressibility plays a critical role in hydrodynamics, such as in the case of blowholes where the vertical upward water-air jet is generated mainly through air compressibility driven by the incident waves trapping air in a temporarily sealed compartment. Accordingly, this study focused on the two-phase hydrodynamic modelling of a blowhole structure with a 4 m diameter in a 2D environment. For the modelling work, mesh-free smooth particle hydrodynamics (SPH) based open-source DualSPHysics tool was used. The two-phase numerical model was validated using published experimental data of a WSI demonstration. 10 plus two-phase simulations were carried out on different scales according to the Froude scaling law to observe the scale effect of air compressibility in small-scale models and the prototype. The findings show that the scale of the air pocket and the air interface significantly affects the structure's performance. At smaller scales, the air exhibits incompressible behavior, and the air compressibility is the main driving force of this water jet that turns ocean wave energy into a powerful water jet. This study shows the importance of incorporating two-phase modelling for analysing such coastal natural structures, and identifying further improvement of these structures as wave energy converters with suitable further optimizations.

Keywords: *Air compressibility, DualSPHysics, Natural blowhole, Two-phase hydrodynamic modelling, Wave energy converters*

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Real-time Voltage Monitoring Using Solar PV Inverters in Distribution Grids

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Abstract

The increasing penetration of solar PV inverters into distribution grids has led to voltage quality issues, particularly over-voltage concerns. Currently, there is no real-time voltage monitoring system in place in Sri Lanka. This work proposes a system for grid operators to monitor voltage at points where solar PV systems are connected. The propsed system extracts real-time voltage data from multiple inverters, which are connected to the internet. The key PQ parameters extracted from the inverters include voltage, current, power factor, and active/reactive power. To retrieve real-time data, the inverter must be connected to the internet. For such internet-enabled inverters, data is accessed through API. In this method, inverter manufacturer's API is accessed through a central server using standard internet protocols. Since each manufacturer provides a unique API, connections must be tailored to the respective brand. User credentials and API access keys authenticate the data retrieval process, ensuring seamless and secure data transmission to the server. Currently, each inverter manufacturer provides its own dedicated platform that supports integration only for inverters of the same brand. This approach is impractical for grid operators, as the presence of numerous inverter brands requires them to log into multiple systems separately - a process that is cumbersome and inefficient. Additionally, grid operators currently lack access to these platforms, which are typically restricted to PV system installers and customers. In the proposed system the extracted data from multiple inverters will be visulized on a map. With this solution, grid operators can monitor real-time voltage levels at any location where inverters are installed. Also historical data from the inverters can be downloaded for further analysis on the over-voltage issues in the grids with PV systems. This will enable operators to efficiently track over-voltage issues and supports decision-making, such as approving new PV connections and proposing solutions to over-voltage problems.

Keywords: *Distribution system, Over-voltage, Real time monitoring, Solar PV inverters*

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A Cost-effective and Scalable SDN Testbed Using Raspberry Pi for Research Purposes

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Abstract

Software-defined networking (SDN) has gained significant momentum due to its numerous advantages, including centralized control, flexibility, and enhanced network management. This shift is supported by the scientific and academic communities for its vendor neutrality, open development, and innovation potential. Typically, emulators like Mininet are used to test new SDN protocols and applications. While they have benefits, they often fail to fully replicate real-world conditions since Mininet does not simulate real-life parameters such as the delay, variation in delay, and loss of packets. In Mininet, all the devices are hosted on the same physical machine, so these physical limitations are hidden, and latencies are often set artificially. To bridge this gap, we look into the viability of setting up an affordable SDN testbed of Open vSwitch (OVS) with programmable boards, particularly Raspberry Pi devices. To assess the effectiveness of the testbed, we use the Ryu controller and a simple four-switch configuration to investigate the feasibility of utilizing Raspberry Pi boards as SDN switches. A comparison was made between the performance of Raspberry Pi 3B+ and Raspberry Pi 4 boards under the same network configurations for different metrics, such as throughput, latency, and the ability to handle multiple connections. This helped us understand how each board performs in various scenarios and identify its strengths and limitations. Moreover, we have tested the compatibility of our testbed to run real-world network applications by running four different applications: routing, load balancing, network security, and network slicing. We verified that each application functions as expected and behaves similarly to Mininet when subjected to the same network conditions. This ensures that our testbed provides a reliable environment for evaluating network applications. Our findings are compared against the performance of Mininet, highlighting the practical advantages and limitations of using Raspberry Pi-based SDN switches.

Keywords: *Software-defined networking, Mininet, Testbed, OpenFlow, Open vSwitch*

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Secure and Energy-efficient Communication Protocol for Wake-up Radio

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Abstract

This research addresses the critical challenge of power efficiency and security in IoT nodes deployed in areas with limited power access. Wake-up radio (WuR) technology is implemented to extend battery life by keeping devices in low-power mode until specific activation signals are received. The study focuses on developing a secure, energy-efficient protocol that operates effectively in non-ideal or lossy communication channels, addressing a gap in previous research which primarily assumed ideal conditions. A token-based security protocol was designed to prevent unauthorized wake-ups that could drain battery power. Theoretical analysis compared power consumption between traditional and proposed protocols across varying node counts and wake-up intervals. Physical implementation validated the protocol's functionality using ESP32 microcontrollers and RF125 modules, with custom-designed 7.2 mH antennas operating at 125 kHz. Experimental results demonstrated significant energy savings in WuR-enabled networks compared to traditional IoT networks, particularly over extended wake-up intervals. The implementation featured real-time power measurement through sensor circuits, with data visualization via a web application. Results confirmed the protocol's effectiveness in maintaining security while achieving superior energy efficiency, making it particularly suitable for applications like remote sensor data collection in power-limited environments.

Keywords: *Energy-efficient protocols, Internet of things, Security protocols, Wake-up radio, Wireless sensor networks*

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Comparative Analysis of Coir Fiber, Banana Fiber, and Synthetic Fibers for Sustainable Composites

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Abstract

This research presents the mechanical properties of reinforced bio-composites using coir and banana fibers with the aim aiming to identify viable ecological replacements to conventional glass fiber reinforced composites. The samples were prepared with natural fiber such as coir and banana. Samples were tested for hardness (ASTM E10), impact energy (ASTM D256), and wear resistance (ASTM G99) tests, while making comparative benchmarks with E- glass and S-glass polyester composites. The Brinell hardness numbers indicated that banana fiber composites were harder than coir fiber composites, outperforming both E-glass and S-glass composites. Both coir and banana fiber composites' impact energy followed with 1.47 J, but lower than the synthetic composites. The wear resistance tests revealed that most coir fiber composites have the least wear percentage, which was at 0.22% , but still higher than the wear percentage in E-glass and S-glass composites. According to these findings, it will suggest that natural fiber-reinforced composites, particularly banana fiber-reinforced composites, possess a higher hardness than conventional glass fiber composites. But they have lower impact energy absorption and higher rates of wear. In other forms of optimization, like fiber treatment or hybridization, could improve such properties and render natural fiber composites. So, they will be more viable alternatives in engineering applications. Further investigations that have been conducted on banana and coconut fiber reinforcement in epoxy composites have revealed that fiber content shows a great influence on mechanical properties. With the optimal fiber weight percentage providing enhanced tensile and impact strengths. Thus, our findings further confirm the feasibility of natural fiber-reinforced composites in the development of green materials with appropriate mechanical properties.

Keywords: *Banana fibre, Coir fibres, Composites, Mechanical properties, Sustainable materials*

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Development of an Automated Bag Feeding System for Small-scale Mushroom Farming

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Abstract

The design of the automated grow bag feeder aims to enhance the efficiency and precision of the filling process by designing and manufacturing a specialized feeding mechanism tailored to the specific requirements of small-scale mushroom cultivation. With mushroom farming automation , directly response to labour shortage and inefficiencies in labour. So, this system proposes a sophisticated solution to facilitate and enhance the entire fill process. This machine includes an advance collection of elements, including a motorised grow bag mouth opening system, with precision-driven gripper and motion systems, an automatic bag holder, and a comprehensive PLC control panel. Some of the most important new features of the design are a vacuum-actuated system that opens and closes grow bags and a lead screw and timing belt setup that makes the whole process smooth and controlled.The repositioning of NEMA (National Electrical Manufacturers Association) motors, aluminium V profiles, and a powerful conveyor system ensures continued handling of grow bags with minimum intervention while ensuring optimal alignment and speed. A screw conveyor and grow media mixer are also integrated into the design to facilitate efficient filling without disrupting workflow. This automated system does away with such manual interventions, thus ensuring consistent and accurate bag feeding. The PLC control allows for real-time monitoring and operations of the system. This gives the user-friendly interface to monitor and manipulate the processes as needed. The design uses a combination of state-of-the-art motors, stepper drivers, and limit switches to maximise both speed and reliability, dramatically cutting down on operational costs. Automating more critical stages of mushroom production, this up and laudable innovation is set to increase productivity while ensuring cheaper labour and sustainability in agricultural practices. With greatly streamlined processes and enhanced control features, this machine marks a substantial step in the modernisation of mushroom farming operations to gain further growth and profitability in the industry.

Keywords: *Bag feeding unit, Bag holder, Filling machine, Mushroom*

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A Review on Experimental Insights into the Impact of Slenderness Ratio on Soil-binder Columns in Soft Soils

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Abstract

The increased need for construction in areas with poor soil conditions, such as peaty clay, necessitates the development of cost-effective and long-term ground improvement strategies. One such technique is the soil-binder column, which combines soil and cementitious materials to generate a strengthened column capable of supporting structural loads. It is still unclear how the slenderness ratio affects the performance of soil-binder columns, especially in very soft soil like peaty clay. Research on slenderness ratio has predominantly focused on concrete columns, such as reinforced or composite types, due to their widespread applications. In contrast, soil-binder columns have received comperatively limited attention. Among the available studies, most focus on soil-cement columns with smaller slenderness ratios and under non-seismic conditions. It has been demonstrated that the slenderness ratio has a major effect on the columns' stability and compressive strength. As slenderness grows, bearing capacity decreases, lateral deformation increases, and the failure mechanism changes. However, no comprehensive research has been conducted on their performance at higher slenderness ratios or their interaction with structures during seismic events. This review emphasises the scarcity of studies that investigate the effect of higher slenderness values on the seismic performance of soil-binder columns. Knowing how these columns behave under dynamic stress is critical for ensuring the safety and stability of foundations in areas like Sri Lanka, where peaty soils and earthquake risks are prevalent. Not only that but also the requirement of further researches to determine the ideal slenderness ratio for soil-binder columns, especially where soft soils and seismic activity are involved. This will improve the design and implementation of this technique for the construction of infrastructure in difficult situations.

Keywords: *Compressive strength, Seismic loading, Settlement, Slenderness ratio, Soil-binder columns*

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Methods Adopted while Micro-tunnelling in Difficult Ground Conditions: A Review

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Abstract

In a congested area, installing a pipeline using an open excavation is not a feasible method. Hence, trenchless techniques are currently being used all over the world. Among different types of trenchless techniques, the most cost-effective method to lay pipes at deeper depths for long distances, is the micro-tunnelling method. Micro-tunnelling is the combination of using remotely controlled Micro Tunnel Boring Machine (MTBM) and pipe jacking technique. Many researchers have explored more on the procedure and the forces that act when driving an MTBM. However, only few research findings are focused regarding the problems encountered when driving an MTBM in difficult ground conditions. Among those, the most significant problem observed when driving a MTBM was the settlement of the MTBM. To overcome this obstacle, many findings suggest to modify the machines and some have utilized ground improvement techniques. Further, to maintain the stability of the tunnel face while driving in saturated cohesionless soil, bentonite slurry was utilized as a temporary support. Sinking of MTBM due to insufficient bearing capacity of soil was resolved through machine modification technique. Settlement of MTBM occurred in Hawaii was resolved by using cement grouting technique. However, driving an MTBM in very soft soil like peat is not a possible task as it possesses poor engineering properties. Although micro-tunnelling has been studied in different soil types, a detailed study on micro-tunnelling in peat has not been studied. Moreover, suitable ground improvement technique has not been found yet to drive MTBM successfully in very soft soil like peat. A case study presented in this study provides the measures required while driving micro-tunnel in soft soil. To overcome problematic nature of soft soil, deep mixing method has been successfully executed in many projects. Hence, this paper emphasizes the importance of ground improvement prior to micro-tunnelling in soft soil.

Keywords: *Deep mixing, Ground improvement technique, Micro-tunnelling, Soft soil, Trenchless technique.*

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The Application of Waste in Cementitious Compounds and Prediction of Properties: A Literature Review

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Abstract

Utilization of cementitious compounds, such as concrete, mortar, and cement paste is predominated in the construction industry. Hence, rising CO_2 emissions, overexploitation of natural resources, and elevated energy consumption for production of raw materials have become serious environmental challenges in the contemporary world. The application of supplementary cementitious materials (SCMs) is considered the paramount solution to this dilemma. However, traditional methods require a substantial amount of time and cost to assess the engineering properties of cement compounds for application of alternative cementitious materials. This study reviews the applications of SCMs in cement compounds and use of the competence of machine learning (ML) techniques to predict engineering properties. Among reviewed literature for concrete, 46%, and 27% studies utilized Fly ash and rice husk ash (RHA), respectively. For mortar, 30%, and 10% studies utilized Fly ash and RHA, respectively. Despite eggshell powder (ESP) being a promising calcium source, either utilization or prediction of engineering properties of eggshell powder-based cementitious compounds has not been previously focused. Among studies combining ML models with cementitious compounds, over 50% focused on concrete, whereas about 40% focused on mortar. Prediction of compressive strength was the main focus in previous studies. Flexural strength, shear strength, split tensile strength, and elastic modulus were not focused even though these are promising engineering parameters to examine the quality of cementitious compounds. ML algorithms, such as Support Vector Machine, Artificial Neural Network (ANN), Decision Tree (DT), and evolutionary algorithms, were mostly applied for predicting the compressive strength of concrete. For predicting the compressive strength of mortar, regression techniques, including linear and ridge regression with boosting methods, were more frequently employed. Recently, a diverse range of ML techniques has emerged, shifting from ANN to DT-based methods and boosting techniques. Ensemble approaches, which integrate multiple ML models to improve prediction accuracy has been less studied.

Keywords: *CO_2 emission, Cementitious compounds, Supplementary cementitious materials, Machine learning*
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Extended Reality Application to Digitally Explore Ancient Heritage Sites in Sri Lanka

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Abstract

Sri Lanka is well-known for its rich cultural heritage and is a place with numerous ancient archaeological sites that attract both local and international visitors. However, traditional methods such as photographs, guided tours, and informational signage often fail to provide an immersive and engaging experience. Furthermore, environmental conditions and increasing demand for tourism continue to threaten the physical preservation of these historical sites. Our study presents the development of an Extended Reality (XR)-based mobile application aimed to enhance the exploration and understanding of Sri Lankan heritage sites through immersive Augmented Reality (AR) and Virtual Reality (VR) experiences. The application digitally reconstructs the selected heritage sites to their original states, enabling users to visualize the ancient structures on top of existing ruins. The application uses Unity 3D and Niantic Lightship platforms for location-based AR, which overcomes the limitation of marker-based methods commonly used in similar applications. Furthermore, a fully immersive VR experience was developed using the Google Cardboard SDK, providing users with a virtual tour of reconstructed environments. An AI-powered chatbot was integrated to improve user interaction and provide site-specific historical information. The prototype was implemented and tested at Lloyd's Signal Tower in Galle Fort, where black box testing was conducted with local and foreign visitors. The performance of the application including, latency, model accuracy, and user experience was evaluated. This study contributes by utilizing location-based AR instead of marker-based AR, using a mobile device as the VR platform instead of requiring an additional device, and integrating both AR and VR features within the same application along with an AI chatbot. This offers a scalable solution to enhance Sri Lanka's cultural heritage and tourism industry. Future work will focus on expanding site coverage and conducting comparative studies with existing heritage applications.

Keywords: *Augmented reality, Cultural heritage, Extended reality, Location-based AR, Virtual reality*

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Enhancing Subfertility Awareness and Knowledge among Women: A Study of Educational Leaflet Intervention in Selected Two Fertility Centres, Sri Lanka

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Abstract

Subfertility describes as any form of reduction of fertility without using contraception within more than a year. Good knowledge regarding subfertility may help to reduce the incidence of infertility, leading to the management of fertility problems. This study was designed to measure baseline knowledge and post-intervention knowledge in subfertile women attending two fertility centers, Karapitiya using an intervention of educational leaflet. The questionnaire was given to the selected women (n = 35) attending subfertility clinics at German-Sri Lanka Friendship Hospital for Women, Galle and Ruhunu Hospital, Karapitiya after obtaining the consent. After providing answers to the questionnaire, educational leaflet was provided to them to improve their knowledge and awareness of the subfertility. Then after three weeks, the same questionnaire was given and answer sheets was collected for assessing the improvement of knowledge. Data were analysed using SPSS 26 software. Paired sample t-test and Chi-square test were used to analyse the data. According to the results, there is a significant association between knowledge improvement on clinical diagnosis and education level ($p < 0.05$). The baseline knowledge is 56.86%. Knowledge after the intervention is 73.75%. Then knowledge improvement is 16.89%. Paired sample t-test showed a significant difference in the average values of the knowledge before the intervention and after the intervention. The average 95% confidence interval for the knowledge improvement was increased as 13.52 for the total group. Total population's baseline knowledge is high compared to the other studies while they have obtained a 16.89% of knowledge improvement after the intervention. However, this knowledge improvement is less in the current study may be due to the high baseline knowledge compared to the other studies. Small sample size is a major limitation. This is a baseline study and further research is needed to determine the awareness effectively using a large population.

Keywords: *Educational leaflet, Fertility center, Infertility, Subfertility*

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A Peptide Inhibitor against Human CTLA-4 and B7-1 Receptor Interaction

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Abstract

Cytotoxic T lymphocyte antigen-4 (CTLA-4) which is expressed on T-cells plays a crucial role in down regulation of the cancer immune response, and inhibitors of this immune check point can be used for treating cancer cells by stimulating the host immune system. Conformationally constrained polypeptides with high selectivity, efficacy, *in vivo* stability, and safety are promising alternatives to antibodies. Here, a selective inhibitor against human CTLA-4 and B7 receptor interaction was identified from improving the binding affinity of previously identified Helix-Loop-Helix (HLH) peptide, using error prone PCR method. Yeast surface-displayed HLH peptide library was constructed using CTLA-4 binding peptide from error prone PCR method and screened against human CTLA-4Ig by using magnetic activated cell sorting (MACS) and flowcytometry. One round MACS and three rounds of fluorescent activated cell sorting (FACS) were performed. The individual clones were identified by DNA sequencing. The screening conditions were improved in each round to have more potent binders. With each round of selection, CTLA-4 binding clones were enriched. Among the enriched clones, eight different clones were identified with affinities below 10 nM with frequencies of either 21% or 7.4%. One of the identified peptide sequences was chemically synthesised. The peptide showed higher binding affinity to CTLA-4, K_D = 56.8 nM in surface plasmon resonance (SPR) in a direct binding assay. Further, the peptide inhibited the interaction between h-CTLA-4 and h.B7-1 with IC_{50} of 1.6 μM. Since CTLA-4 is a critical immune checkpoint that restricts the cancer immune response, this inhibitory HLH peptide represents a new class of drug candidates for immunotherapy.

Keywords: *Affinity maturation, CTLA-4, HLH-peptides, Immune checkpoint inhibitors*

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Challenges for the Importation of Biopharmaceutical Products in Sri Lanka

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Abstract

Biopharmaceuticals, which are derived from biological sources such as humans, animals, or microorganisms, include sugars, proteins, nucleic acids, and living cells or tissues. These products are highly specific and target only certain molecules in the body, making side effects less frequent compared to conventional synthetic drugs. Biopharmaceuticals are seen as breakthrough solutions for serious health issues and represent the future of the pharmaceutical industry. However, Sri Lanka is still in the early stages of adopting biopharmaceuticals, relying solely on imports. In fact, 45% of pharmaceutical imports include biopharmaceuticals in Sri Lanka. The aim of this study was to explore the background of the pharmaceutical companies importing biopharmaceutical products in Sri Lanka and to examine the regulatory challenges they face. A mixed-method survey was conducted using an interviewer-administered questionnaire with mostly open-ended questions. Eight of the 25 market authorization holders participated in the study. Quantitative data were analyzed using SPSS, and qualitative data underwent manual thematic analysis. The findings revealed that most (62.5%) companies were sole proprietorships, and half had been operating for over 10 years. Half of the companies also reported annual revenues exceeding 10 billion LKR, though 87.5% of importers had no subsidiaries beyond one location. Two main categories of challenges were identified. First, regulatory issues specific to the National Medicines Regulatory Authority included outdated and poorly implemented policies, lack of transparency, lengthy dossier evaluation times, high evaluation fees compared to general products, inefficiency, inexperienced assessors, and even dossier misplacement during external evaluations. Secondly, company-specific challenges, that are involved with inadequate infrastructure for cold chain maintenance and difficulties in product recalls.

Keywords: *Barriers, Biopharmaceutical products, Challenges, Importation, Regulatory compliance*

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Investigation of Medication Storage Patterns in the Households of Allied Health Sciences Undergraduates of Sri Lanka

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Abstract

The potency and efficacy of medicines are affected by their storage conditions. Improper home storage could result in a shorter expiry than the package-indicated date. Several studies have reported immense malpractices in the home storage of medicines. A descriptive cross-sectional study was conducted using an online Google Form among the undergraduates of the Faculty of Allied Health Sciences in Sri Lanka. Among the 203 respondents, there were more females (79.31%), and most (83.74%) were between the ages of 20 and 25. The median (IQR) family size was 4 (1). Of the participants, 86.21% were from the University of Ruhuna and 13.79% were from other universities. Among the total, 45.32% studied in their second academic year. About 92.12% confirmed that medicines were stored in their house. Most households (40.11%) had 1-5 medicines. Tablets (99.01%) were prevalently stored following creams/ointments (82.76%) and capsules (75.37%). The most common storage place was bedroom (78.82%). Although no one kept medicines in the bathroom, some (12.32%) used to store in the kitchen. Only a few kept medicines where directly affected by the sunlight (6.9%), in the refrigerator (2.96%), and inside vehicles (0.99%). One-fourth of the respondents stores suspensions/syrups (25.62%) and injections (24.63%) in the refrigerator. About 70.94% always kept medicines in the original package, while 56.46% kept them in the package received from the hospital/pharmacy. Only 18.72% always shifted them to a convenient container. Although 8.87% always took storage instructions from the pharmacist, 58.62% always followed such instructions. About 9.26% always followed the storage instructions of the package insert. It was concluded that the most common storage place was bedroom while majority of the participants kept their medicines in original package. Fewer participants took storage instructions from the pharmacists. Maintaining optimum storage conditions is essential to maintain the quality and therapeutic effectiveness of pharmaceutical products.

Keywords: *Drug storage, Household, storage, Students, Unused medicines*

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Cognitive Impairment in Hip Fracture Patients in Southern, Sri Lanka

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Abstract

The prevalence of cognitive impairment (CI) increases with advancing age and it is a leading cause of falls and fractures among older adults. This study assessed the prevalence and factors associated with CI among hip fracture (HF) patients admitted to National Hospital, Galle, Sri Lanka. A total of 209 consecutive patients with incident HF admitted between May 2023 and May 2024, aged 40 years or more were studied. CI was evaluated soon after the admission using the Sinhala version of Mini Mental State Examination tool (MMSE). Pre-fracture physical function, frailty, sarcopenia, nutritional status were assessed using the locally validated Barthel Index, Frail Non-Disabled (FiND) questionnaire, SARC-F tool and Mini Nutritional Assessment (MNA) tool respectively. Independent t- test and One way ANOVA test were used to identify the associated factors. Ethical approval was obtained from Ethical Review Committee of Faculty of Medicine, University of Ruhuna. Among 209 subjects, 151 (72%) were females while 150 (71.8%) were married. The mean age (±SD) of HF patients was 73.8 (11.3) years. Of 209 patients, 113 (54.1%) had CI at the time of admission. Of those with impaired cognition, 23% and 26.8% had mild (MMSE score 21 - 24 and moderate (MMSE score 10 - 20) CI respectively while 4.3% had severe CI (MMSE score 0 - 9). Female gender ($p = 0.035$), advanced age ($p < 0.001$), poor living arrangement ($p = 0.025$), poor nutritional status ($p = 0.038$), disability ($p = 0.001$), and physical dependence ($p = 0.01$) having higher risk of developing CI. Further, pre-fracture sarcopenia and frailty also associated with CI ($p < 0.001$) among HF patients. Previous fractures and ASA scoring did not show associations with CI ($p > 0.05$). This study reveals that cognitive impairment is prevalent among HF patients. Advanced age, female gender, poor nutritional status, physical function, frailty, and sarcopenia were significantly associated with CI. These findings highlights the importance of early identification and targeted interventions to address risk factors, which can help to reduce the risk of developing CI.

Keywords: *Associated factors, Cognitive impairment, Hip fracture, Prevalence*

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Antidiabetic Activity of Bael Fruit Aqueous Extract Encapsulated Alginate Nanoformulation in Streptozotocin-induced Diabetic Rats

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Abstract

Nanoencapsulated herbal extracts reveal novel prospects in the development of drug leads against diabetes mellitus. This study attempted to assess the antidiabetic effect of bael fruit aqueous extract encapsulated alginate nanoformulation (BAq-AN) in streptozotocin (STZ)-induced diabetic rats. Bael fruit aqueous extract encapsulated alginate nanoformulation was prepared using the ionic gelation method, mixing alginate to freeze-dried bael fruit extract at 3:1 w/w. Wistar rats (n = 6 per group) were randomly assigned to healthy control (Group 1), STZ-induced control; 60 mg/kg, ip (Group 2), and treatment groups. Group 3 was assigned to metformin at 300 mg/kg. Three groups (4 - 6) were allocated for bael fruit aqueous extract at doses (210, 425: equivalent therapeutic dose, and 850 mg/kg. The last three groups (7 - 9) were assigned to BAq-AN at 155, 310: equivalent therapeutic dose, and 620 mg/kg. Doses in treated groups were calculated based on percentage yield of bael fruit extract and the loading capacity of its nanoformulation. Each treatment was administered orally for 28 days continuously. The serum fasting glucose, insulin level, and glycated hemoglobin (HbA_{1C}) percentage were estimated using standard assay kits. Homeostatic model assessment-β cell function (HOMA-β) and homeostatic model assessment-insulin resistance (HOMA-IR) were calculated. Ethical clearance was granted by ERC, Faculty of Medicine, University of Ruhuna (19.9.2018.3:2). The reduction of HbA_{1C} percentage was more pronounced in the BAq-AN treated groups of rats (310, 620 mg/kg) at 44.8% and 44.5% than their respective crude extracts treated groups of rats (425, 850 mg/kg) respectively. BAq-AN-treated diabetic rats possessed a significant reduction of serum glucose levels at 18.53%, 25.16%, and 8.15% at the doses of 155, 310, and 620 mg/kg, respectively. The mean insulin level and HOMA-β were significantly ($p < 0.05$) increased, while HOMA-IR values significantly decreased upon the treatment with all three doses of BAq-AN. The insulin level and HOMA-β of the BAq-AN (155 mg/kg) were improved by 3.26% and 36.88% respectively compared to its crude extract-treated rats. BAq-AN exerts antidiabetic activity in STZ-induced diabetic rats and is found to be a promising candidate for development as a nanoencapsulated drug lead against diabetes mellitus.

Keywords: *Alginate, Bael fruit, Nanoencapsulation*
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Effectiveness of Telemedicine Interventions on Improving Medication Adherence of Patients with Type 2 Diabetes: A Review

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Abstract

Type 2 diabetes has been identified as one of the most prevalent chronic diseases worldwide. Effective management of diabetes relies heavily on adherence to medications. However, nonadherence remains a critical issue in patients with chronic diseases. Numerous interventions have been implemented worldwide and Telemedicine has become prominent due to significant technological advancements. The aim of this review is to analyze the impact of telemedicine interventions on enhancing medication adherence in patients with type 2 diabetes. Original research papers published in PubMed and Google Scholar from 2014 to 2024 were searched using the keywords “Intervention”, “Medication adherence”, “Pharmacist”, “Telemedicine”, and “Type 2 diabetes”. Research related to multiple comorbidities, special populations, written in languages other than English was excluded. The search resulted from 14 original research papers including 5447 patients. 12 studies were randomized controlled trials. Direct telephone calls (n = 9), regular text messages (n = 5), WhatsApp messages (n = 1) and several smartphone applications (n = 3) were identified as the approaches used to implement telemedicine interventions. Medication adherence was assessed using different strategies such as Proportions of days covered, Pill counts and Medication Adherence Scales. The outcome measure of most of the studies was HbA1c. A significant improvement in HbA1c level was observed in patients who recieved the telemedicine intervention in seven studies. The results of six studies have demonstrated that telemedicine interventions improved medication adherence in the intervention group, compared to the control group with telephone calls being the most frequently used telemedicine approach. In conclusion, telemedicine is an effective strategy that can be used to improve medication adherence in patients with type 2 diabetes and the findings highlight the possibility of incorporating telemedicine in improving medication adherence.

Keywords: *Intervention, Medication adherence, Pharmacist, Telemedicine, Type 2 diabetes*

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Insulin Self-administrating Practices Among Patients with Diabetes: A Cross-sectional Study in Sri Lanka

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Abstract

Majority of patients who are on insulin therapy do self-administration of their daily insulin doses subcutaneously. Proper insulin administration technique is crucial in delivery of the prescribed dose. This study aimed to evaluate insulin self-administration practices among patients who were treated with insulin. A descriptive cross-sectional study was conducted at the Diabetes and Endocrine Outpatient Clinic in a secondary healthcare setting in Sri Lanka. Patients with diabetes between 20 - 80 years of age who were on insulin therapy were recruited to the study sample (n = 200). A structured, content validated and interviewer-administered questionnaire was used to collect data related to socio-demography, clinical data and practices related to insulin self-administration. Data were analysed by SPSS version 26. $p < 0.05$ was considered statistically significant. Mean (±SD) age of the participants was 55 (±11) years. Majority (73.0%) were females. 94.0% (n = 188) were in low-income category. Of the participants 36.5% (n = 73) were treated with insulin for > 5 years. All participants cleaned hands prior to the injection and 86.5% cleaned the injection site before injection. Approximately 36.5% always injected insulin to the abdomen. About 35.5% did not make a skinfold when injecting insulin subcutaneously and 54.5% injected insulin at an angle of around 45 degrees. 89.0% were reusing the needle. All the patients were taking their insulin dose shortly before meals and 31% sometimes missed the insulin dose. 50% of the patients stored insulin in the door of the refrigerator. In conclusion administering insulin always to the same site, not making a skin fold, reusing the insulin needle and missing insulin doses are the poor practices observed among patients who are self-administering insulin. These poor practices could fail the delivery of the expected insulin dose while increasing the risk of contamination and irritation in the injection site. Poor adherence could lead to therapeutic failure causing multiple complications. İmplementing education programmes to improve insulin self-administration practices will be helpful to enhance therapeutic outcomes in patients with diabetes.

Keywords: *Diabetes, Insulin, Practices, Self-administration*

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Knowledge, Attitudes and Practices towards Rabies: A Cross-sectional Study at National Hospital Galle

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Abstract

Rabies is a neglected tropical disease of poor and at-risk groups of the country who receive less community attention. A descriptive cross-sectional study was carried out among the service beneficiaries of the rabies diagnostic unit at the National Hospital Galle during the period from January 2020 to December 2023 to assess knowledge, attitudes and practices towards rabies. A total of 113 participants were enrolled in the study, of whom 96.5% were Sinhalese and the rest were Muslims. Mean age was 44.2 (± 12.8) years, and 66% of the study subjects were males. Of the participants, 38% were professionals, 40% were skilled personnel and 22% were unemployed. Friends/ neighbours (96.5%), media (78%) and schools (89%) were the main sources of information on rabies for the participants. Only 40% were aware that rabies is an infectious disease and 61% knew that it is a preventable disease. All of them knew that dogs and cats transmit the disease via bites, scratches and aerosols. However, 69% believed the possibility of transmitting the disease by rats. Almost all the participants believed vaccination of dogs/cats as a preventive measure to control rabies and 70% knew that vaccination needs to be done annually. Majority of the participants believed that seeking medical advice, having first aid, checking animal vaccination history, observing animal behaviour, having complete course of post-exposure vaccination are important as post exposure prophylaxis measures. Among the study subjects, 83% had experienced dog bites and more than 80% of them sought medical advice following appropriate first aid and brought animal heads for rabies diagnosis together with vaccination records. The results revealed satisfactory level of knowledge, attitudes, and practices on rabies among the service beneficiaries of the rabies unit. However, an extended survey among general public is warranted for further controlling of the disease.

Keywords: *Attitudes, Knowledge, Practices, Rabies, Southern province*

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Acceptability of Long-acting Reversible Contraception Among Women in Childbearing-age: A Literature Review

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Abstract

Modern contraceptive methods, mainly long-acting reversible contraceptives (LARCs), are effective in reducing unwanted pregnancies while helping family planning. However, the adoption of LARCs is influenced by several factors such as safety concerns, side effects, cost, accessibility, and socio-demographic and cultural variations. This literature review investigates patterns of LARC use, and barriers to the adoption of LARCs, A review of materials was carried out systematically from databases including PubMed, and Google Scholar. The keywords include "Childbearing age women", "LARCs", "Acceptability", "Barriers to modern contraceptives", and "Traditional and modern contraceptive methods". Articles that were written in the English language and published between the year 1978 and 2024 were considered to the review. The articles published before the year 1978, studies concerned only with male contraception and non-peer-reviewed articles; were excluded. The study reviewed 12 articles including 724,101 participants in which 9 cross-sectional studies, 1 a narrative literature review, 1 controlled interrupted time series design, and 1 a policy-focused narrative review with expert consensus recommendations. The literature review revealed that modern contraception is well-known, but attitudes and social barriers prevent widespread implementation. Older, married women, and those who do not plan to have children are more likely to adopt LARC procedures. Contraceptive use varies by level of education such that less educated women use traditional and educated women use modern contraceptives once they experience negative side effects. Contraceptive use is influenced by health and culture, and thus programs must intervene on misinformation, improve partner communication, and educate on the value and safety of modern contraceptives.

Keywords: *Acceptability, Barriers to modern contraceptives, Childbearing age women, Long-acting reversible contraception, Traditional and modern contraceptive methods*

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Evaluation of *In-vitro* Anti-bacterial and Blood Coagulation Effects in Leaves of *Justicia gendarussa*

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Abstract

As folklore medicine, leaves of *Justicia gendarussa* have been used for wound healing effects in several countries. Ethanolic extract of leaves of *J. gendarussa* had been examined in vitro for anti-microbial activities. This study aimed to evaluate the *in-vitro* blood coagulation and anti-bacterial effects of its aqueous leaf extract. Plant was authenticated by National Herbarium, Peradeniya. The crude extract was prepared by homogenizing the leaves in water for 24 hours, followed by filtration and centrifugation. In phytochemical screennig, flavonoids, phenolic compounds, alkaloids, and carbohydrates were found in crude extract. The anti-bacterial activity was tested against *Staphylococcus aureus* (ATCC 25983), *Pseudomonas aeruginosa* (ATCC 15442), *Escherichia coli* (ATCC 25922), and Methicillin-resistant *Staphylococcus aureus* (MRSA) using the disc diffusion method. Synergistic activity was evaluated for the crude extract by comparing the zone of inhibition with framycetin sulphate. Blood coagulation activity was evaluated by comparing clotting time with a concentration series of tranexamic acid and a concentration series of crude aqueous extract. In the anti-bacterial assay, zone of inhibition against MRSA was increased for the combination of framycetin sulphate and the crude extract than framycetin sulphate alone. In the blood coagulation assay, minimum clotting time was observed for the tranexamic acid which was employed as the positive control at the concentration of 125 mg/mL, while the clotting time was increased at concentrations above and below 125 mg/mL. The lowest clotting time was observed at the concentration 62.5 mg/mL of the crude extract. The synergistic effect between framycetin sulphate and crude extract was more effective against MRSA. In the blood coagulation assay, maximum blood clotting time was observed in higher and lower concentration series of tranexamic acid. In higher concentrations of crude extract, blood clotting time was observed to be infinite.

Keywords: *Antibacterial, Blood coagulation, Clotting time, J. gendarussa, Synergistic effect*

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A Logistic Regression Approach for Breast Cancer Prediction in Sri Lanka

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Abstract

Breast cancer is the most prevalent type of cancer among Sri Lankan women, with relatively low survival rates compared to developed countries. Over 3,000 new cases are diagnosed annually, according to the Sri Lanka National Cancer Registry. This study aims to model and predict breast cancer occurrence using Logistic Regression (LR). Data were obtained from the National Cancer Institute, Maharagama, and the Teaching Hospital, Ratnapura, with 250 patient records analyzed, each containing 15 features, including demographic, laboratory, and mammography attributes. The study identified key risk factors: married women had slightly higher odds of developing breast cancer (OR = 1.076), while a family history of breast cancer slightly reduced the risk (OR = 0.94848). Women with positive Estrogen Receptor (OR = 1.4437) and Progesterone Receptor (OR = 1.8456) statuses had a higher risk. Increasing age was associated with a small increase in risk (OR = 1.03418), and those with a history of breast cancer had a higher likelihood of recurrence (OR = 1.4398). Women who had given birth had a slightly lower risk compared to those who had not (OR = 0.946). Breast cancer was less likely to occur in the right breast (OR = 0.839), and positive HER-2 status was linked to decreased odds (OR = 0.645). The findings can help healthcare policymakers in identifying high-risk individuals, improving screening programs, and promoting awareness campaigns. Recommendations include enhancing screening, integrating hormone receptor testing, targeted awareness programs, and further research using larger datasets and advanced models. Additionally, lifestyle modifications such as regular physical activity, maintaining a healthy diet, and reducing exposure to known risk factors should be emphasized in public health initiatives. By implementing these measures, Sri Lanka's healthcare system can enhance early detection and prevention strategies, ultimately improving breast cancer survival rates and reducing the overall burden of the disease.

Keywords: *Breast cancer, Logistic regression, Odds, Odds ratio, Sri Lanka*

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Tidal Energy Forecasting and Power Generation in Sri Lanka using ARIMA Fourier Models: A Case Study of Trincomalee

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Abstract

Sri Lanka is an island in the Indian Ocean and generates electricity from thermal power, hydropower, and other renewable energy sources such as solar and wind power. The country is expected to achieve 70% electricity demand through renewable energy by 2025. Although the country's geographical location offers the feasibility of tidal energy generation, the country has not expanded renewable energy enough. Tidal energy emerges as a promising new frontier in the power generation process with the initiation of lagoons instead of high-cost tidal barrages. In this study, Trincomalee Bay is selected as the study area, and a comparative analysis of time series models was conducted to forecast tidal ranges. A further novel power generation model was introduced to calculate the potential power by incorporating turbine efficiency, gravitational acceleration, and seawater density. Daily tidal range data for the period 2021 to 2023 from the National Aquatic Resources Research and Development Agency website was selected and validated through the cubic spline interpolation technique. Among the SARIMA (Seasonal Autoregressive Integrated Moving Average), Hybrid model (ARIMA with Fourier transform), LSTM (Long Short-Term Memory), and Prophet forecasting model, the LSTM model outperforms with a mean squared error (MSE) of 0.0040 and a 0.52 MW and 3.43 MW power prediction per day. Results indicate that tidal energy presents a promising avenue for Sri Lanka's energy generation for the national grid and encourages policymakers and engineers to further investigate tidal power generation, incorporating environmental factors.

Keywords: *LSTM, Prophet, Renewable energy way, SARIMA, Tidal energy*

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PhD Program Recommendation System: A Shiny App for Matching Applicants to University Requirements

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Abstract

The rising demand for graduate programs has created a need for a more efficient system to help potential students choose the right universities. This study presents the development of a PhD Program Recommendation System using R Shiny. The novelty of this system lies in its interactive design that offers real-time, personalized PhD recommendations using data-driven methods. The system is based on a dataset with the requirements for graduate admissions into USA universities, such as GRE, English test scores, and indicators related to research focus. Its user interface enables candidates to enter their academic profile details including GRE score, English tests (TOEFL, IELTS, etc), GPA and research experience. The app then dynamically filters universities that fit the qualifications of the candidate based on this input. We have used a cosine similarity algorithm to check the gap between what the candidate enters on his/her profile and university data. Each vector is normalized with L2 norm scaling to produce a better similarity score than raw counts, which is especially important when comparing universities across differing scales. The key result of the application includes a list of matched universities ranked in order, accompanied by details on required scores and research interests based on the similarity score. Second, there is a bar plot visualization showing comparative similarities of the candidate to the selected universities for better decision-making. The system is dynamic, in that as the user provides input to the system, recommendations change in real time. It will bridge the gap between students and universities by recommending appropriate PhD admissions with data-driven insights. The automation reduces manual search complexity, mitigates the risk of unsuccessful applications, and helps avoid unnecessary expenses by targeting programs that best align with the candidate's profile. While the system works well, it is limited by the available data and may not cover all aspects of university admissions. Future updates will expand the dataset and incorporate user feedback to improve the recommendations. This tool serves as a valuable resource for prospective PhD candidates, providing personalized, data-driven insights to navigate the highly competitive landscape of securing PhD opportunities.

Keywords: *Academic profile matching, Cosine similarity, Graduate admission prediction, Personalized university recommendations, PhD program selection*

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