5TH INTERNATIONAL CONFERENCE OF AGRICULTURAL SCIENCES -2024

ABSTRACTS

"AGRICULTURAL RESEARCH TO ADDRESS FUTURE CHALLENGES OF CLIMATE CHANGE AND FOOD SECURITY"

11TH SEPTEMBER 2024

FACULTY OF AGRICULTURAL SCIENCES

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Sabaragamuwa University of Sri Lanka

"Agricultural Research to Address Future Challenges of Climate Change and Food Security"

11th September, 2024

ABSTRACTS

AgInsight 2024

Faculty of Agricultural Sciences,

Sabaragamuwa University of Sri Lanka,

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5th International Conference of Agricultural Sciences

11th September 2024

"Agricultural Research to Address Future Challenges of Climate Change and Food Security"

ABSTRACTS

Key Tracks

Agribusiness and Agricultural Economics
Agriculture and Agri-Environment
Livestock, Aquaculture and Food Science

Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka,
P.O. Box 02,
Belihuloya, 70140
Sri Lanka.

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Keynote Address

Professor Harold Corke
Department of Biotechnology and Food Engineering,
Guangdong Technion – Israel Institute of Technology, (GTIIT)
Shantou, China.

The First and the New Green Revolution

The Green Revolution of the 1960s was a response to catastrophic hunger levels in many regions of the world. Human populations were increasing faster than rate of increase in food production, and there was deep pessimism in some quarters as to whether technical solutions were even possible. Finally, a combination of scientific, political, and economic factors enabled a transformation of global wheat and rice production, and rapid increases in yield had great effects in improving the livelihoods of many rural people. The hungriest country – India – became a major grain exporter. The genetic base for this Green Revolution was the development of dwarf rice and wheat that could tolerate high nutrient inputs without lodging. The economic base was the development of technology packages (chemical inputs, equipment, training, financial support) that allowed small farmers to utilize the new varieties. A major impetus for real progress in India was the use of wheat exports by the USA as a political weapon – Indian politicians realized that security and sovereignty demanded a degree of self-sufficiency in staple grain production.

I will review the first Green Revolution, and then discuss the situation prevailing now in 2024. The global population has more than doubled since 1964, yet the percentage and even the absolute number of people who are hungry every day has decreased. However, yield progress has slowed, populations are still rising, there are severe environmental problems particularly related to water supply, and levels of waste or distribution inefficiencies are far too high. Further, the conflict between Russia and Ukraine reminds us that politics and war can interfere with the secure production of agricultural inputs, and with the production and export of food grains to countries that are far from self-sufficient.

Then I will examine the systems and technologies that may contribute to a successful New Green Revolution. These include a) mobilization of genetic resources combined with a greater understanding of polygenic traits, understanding genotype x environment interactions, fully utilizing technologies such as CRISPR, incorporating AI and robotics further into plant breeding; b) automated/ robotic systems to ensure maximum efficiency of use of water and agricultural chemicals built into sustainable supply chain analysis; c) increased focus on the needs of rural populations, to ensure that they can implement, use and benefit from advanced technologies; d) deeper understanding of the real needs of consumers and the provision of food that supports long term human health; e) political reform where countries individually think clearly about their vulnerabilities to agricultural supply chain disruption, and where countries collectively commit to ensuring free movement of basic foods and agricultural inputs.

Message from the Vice Chancellor Sabaragamuwa University of Sri Lanka

Prof. M. Sunil Shantha

It gives me a great pleasure to extend my heartiest congratulations for the 5th International Conference of the Faculty of Agricultural Sciences Sabaragamuwa University of Sri Lanka (AgInsight 2024) under the theme of "Agricultural Research to Address Future Challenges of Climate Change and Food Security." As one of the pioneering faculties of the university, Faculty of Agricultural Sciences has always boldly harboured its academic responsibility and this is indeed a historic milestone of the faculty.

It is evident that the condition of the environment is worsening from year to year. In the context of developments, the population may perceive the negative consequences of this tendency only slightly. However, in the future, it is highly likely to threaten the life of the entire humanity. Climate change has a direct impact on food supplies and security, and for this reason, it is crucial to take appropriate measures in order to prevent the aggravation of the situation. Otherwise, droughts, lack of water, the rise of ocean level, and other numerous negative consequences may lead to global hunger, as food production will be impossible in these circumstances.

However, I am confident that the Faculty of Agricultural Sciences will hold this conference to meet the global standard.

I extend my sincere thanks and congratulations to the organizing committee, keynote speakers, paper presenters and the participants of the conference and wish them all success.

Professor M. Sunil Shantha,
Vice-Chancellor,
Sabaragamuwa University of Sri Lanka.

Message from the Dean
Faculty of Agricultural Sciences

Snr. Prof. P. M. Asha S. Karunaratne

As the Dean of the Faculty of Agricultural Sciences of the Sabaragamuwa University of Sri Lanka, I am delighted to issue this message to the proceedings of the 5th International Conference of the Faculty of Agricultural Sciences (AgInsight 2024).

The Conference is organized around the theme of "Agricultural Research to address future challenges of climate change and Food Security" aims to generate multidisciplinary, stimulating, and critical discussions concerning futures of food systems. The event promotes networking between people interested in futures issues from different perspectives on climate change and food security.

The global consumption of natural resources has accelerated since the industrial revolution, in pursuit of development and economic growth. With the emergence of climate and other ecological crises, it is now acknowledged that the rate and patterns of consumption are neither sustainable nor equitable. The vested interests, and related structures of economic and political power, play a central role in maintaining a status quo, characterised by short-term thinking and a priority on profit maximisation. Within these conditions, the perspective of the future of humanity and of the natural world on which we depend is marginalized. This prompt empirical, philosophical, policy and practice questions, on the social and environmental consequences of continuing this path, on the role and value of nature, and on what would a transformed relationship between humanity and natural resources look like?

The hard work and dedication of the organizing committees during preparation for this conference is highly appreciated.

I extend my best wishes for the success of the conference.

Senior Professor P. M. Asha S. Karunaratne,
Dean/Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka

Message from the Conference Chair

Prof. P. Kapila Dissanayake

The members of the organizing committee and myself are very proud to present the 5th International Conference on Agriculture (AgInsight 2024) under the theme of "Agricultural Research to Address Future Challenges of Climate Change and Food Security" and welcome all participants to the conference.

Scientific research is the main reason for the present development of mankind on this planet. Identifying the behaviors of materials on earth makes humans think of uses for those materials and, hence, the development of survival strategies. As the planet is not an absolute constant, all living things are in potential danger of adverse changes in environmental conditions. Among the dangers, climate change and food security can be considered two of the most important problems we have when human survival is a concern. Scientists in every corner of the world are trying to identify problematic situations and solutions. This knowledge should be made available for every scientist to go for better solutions with a broad understanding. A scientific conference is one way of getting out the new knowledge created in isolated locations. Therefore, I am happy to be a chair of this conference, as it potentially supports the scientific world in making better solutions in the future for the sake of the survival of humans and other organisms on the planet, at least on a minor scale.

Agriculture, on the other hand, is the most vulnerable operation that is directly affected by climate change and, hence, food security. The theme of AgInsight 2024 is, therefore, a timely important theme to highlight the importance of understanding climate change and food security for better solutions.

I am delighted to say that AgInsight 2024 is ready to provide a platform for more than 100 researchers to publish their findings and thoughts among the scientific community. The conference includes a wide range of disciplines in agriculture, ranging from basic to applied research, which are presented in this conference under three sessions such as Agriculture and Agri Environment, Agribusiness and Agricultural Economics, and Livestock and Aquaculture.

I hope this conference is unique, and I extend my thanks to all the presenters for their contributions to making the event a success. Further, all academic and administrative staff of the university should also get my sincere thanks for giving their hands to the success of the conference.

Professor P. Kapila Dissanayake,
Conference Chair,
5th International Conference of Agricultural Sciences

Plenary Session: Livestock, Aquaculture, and Food Science

The Cutting Edge of Poultry: Sri Lanka's Journey Through Challenges and Technological Advancements

By Ajith Weerasinghe,
Group CEO,
CIC Feeds Group,
CIC Feeds (Pvt. Ltd.)

The past several years, the Sri Lankan poultry industry went through massive challenges which were not distinctive to the Industry. It navigated with the impacts of Easter bomb attack, followed by the global COVID-19 pandemic and the ongoing economic crisis in the country. The Industry had faced significant hurdles, including difficulties in acquiring essential raw materials, Industry related multiple inputs, pharmaceuticals and grandparent/parent stock due to dollar scarcity in the country. These challenges have led to a surge in production costs as the Rupee depreciated and a decline in consumer demand, placing considerable strain on the sector.

Despite these obstacles, the industry has shown remarkable resilience and adaptability. What began as backyard poultry farming has evolved into a highly advanced sector where large-scale producers predominantly utilize closed-house systems for broiler production. Leading Industry players have integrated their operations, managing their own feed mills, broiler farms, processing facilities and parent stock, ensuring efficiency and self-reliance.

Today, the Industry is slowly beginning to stabilize. A key strength has been its adherence to world-standard production parameters such as Feed Conversion Ratio (FCR) and average body weight which have been instrumental in sustaining the industry through this challenging times. As we look to the future, these strengths will continue to support the growth and recovery of Sri Lanka's poultry industry.

Plenary Session: Agriculture and Agri-Environment

Modern Technologies for Sustainable Farming of Fruits and Vegetables

By Dr. Julian Velez
Consultant,
Agriculture Sector Modernization Project

Since 2018 the Agricultural Sector Modernization Project (ASMP), sponsored by the World Bank, has introduced modern technology for the sustainable farming of selected fruits and vegetables. Some of the pillars of the introduced technologies are improved land preparation and drainage, high density horticulture, low pressure irrigation, fertigation based on soil testing and the phenology the crops, the use of agricultural plastics, IPM practices to minimize the use of pesticides, Espalier trellising, harvesting by age using fruit tagging, post-harvest technology and cold chain and export protocols to ship Sri Lankan products to export markets using reefer containers. Close to 10,000 farmers in 12 Districts have benefitted from these technologies that in the majority of cases have more than doubled productivity. The Project will end in December 2024.

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Rapporteur: Ms. N. M. H. I. Nayakarathne
Session Coordinators: Ms. N. M. H. I. Nayakarathne / Ms. A. A. D. U. D. Premarathna

Track: Agriculture and Agri- Environment
Thematic Area: Biodiversity and Community
Session Chair: Prof. E. P. N. Udayakumara
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Session Coordinators: Ms. N. M. H. I. Nayakarathne / Ms. A. A. D. U. D. Premarathna

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Agriculture and Agri-Environment

Revolutionizing Farm Mechanization for Sustainable Agriculture: A Comprehensive Review of Innovative Technologies, Environmental Impacts, Economic Viability, and Future Prospects

S. M. A. B. K. Samarakoon[1*], H. T. D. Dilshan[1] and C. P. Rupasinghe[1]
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ABSTRACT

The agricultural sector is undergoing a transformative phase globally, marked by an increasing emphasis on sustainability, efficiency, and technological integration. This comprehensive review delves into the realm of farm mechanization, exploring innovative technologies that are revolutionizing agricultural practices. It examines the environmental impacts, economic viability socially equitable in future prospects of these advancements, providing a holistic perspective on the evolving landscape of sustainable agriculture. Articles were reviewed from the year 2017 through 2024 using PRISMA as a guideline based on the research topic, methodology, data requirements, and practical applications. Relevant scientific works already published on the topic were searched for in the Scopus, Web of Science, ScienceDirect, IEEE, MDPI, and PubMed databases. The review instigates by contextualizing the need for sustainable farm mechanization in light of growing population pressures, climate change challenges, and resource constraints. The role of innovative technologies in addressing these complex issues, emphasizing their potential to enhance productivity while minimizing environmental harm are considered. This involves in application of precision farming technologies with sensor-based image analysis, integrating renewable energy in farming operations, smart agricultural practices with automation, vertical farming with hydroponic, etc. Innovative technologies are applied to optimize resource use, reduce chemical inputs, and enhance crop yields. Furthermore, their potential to mitigate soil erosion, water pollution, and greenhouse gas emissions is contributed, highlighting their positive environmental impacts. The economic feasibility of adopting these technologies is a key focus in the role of government policies, subsidies, and incentives in promoting mechanization adoption among smallholder farmers. The artificial intelligence, blockchain technology, and data analytics, which are poised to further revolutionize agricultural practices as emerging trends. The importance of fostering collaboration between researchers, policymakers, industry stakeholders, and farmers is emphasized as a critical enabler of sustainable mechanization strategies. In conclusion, this review underscores the pivotal role of innovative farm mechanization technologies in advancing sustainable agriculture. By harnessing technological advancements, optimizing resource utilization, and promoting eco-friendly practices, the agricultural sector can achieve greater resilience, productivity, and environmental stewardship. The insights provided herein serve as a valuable resource for policymakers, researchers, practitioners, and stakeholders seeking to navigate the evolving landscape of modern agriculture.

Keywords: *Autonomous vehicles, Farm mechanization, Innovative technology, Precision agriculture, Robotic systems, Senor-based monitoring*

UAVs Application in Precision Agriculture

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ABSTRACT

Unmanned Aerial Vehicles (UAVs) have emerged as transformative tools in modern agriculture, offering a versatile platform for data collection and analysis. The importance of UAVs in Precision Agriculture lies in their ability to provide timely and high-resolution spatial and temporal images for decision-making. This review aims to provide an overview of the potential and practical applications of UAVs in Precision Agriculture. Key applications include crop health monitoring and crop scouting, water stress assessment, disease and pest detection, nutrient deficiency identification, crop spraying, aerial mapping, irrigation management, yield estimation, biomass assessment, and weed detection. This technology helps for taking decision in real time which enables the effective application of agricultural inputs with right practice at right place in right time with precise quantity. UAV technology offers advantages such as increased efficiency, reduced labor costs, and enhanced Precision in Agricultural operations. However, challenges including regulatory constraints, limited flight endurance, and data processing complexities need to be addressed for widespread adoption. By examining the applications, advantages, and challenges of UAVs in Precision Agriculture, this review highlights the transformative potential of UAV technology in addressing the evolving needs of modern farming practices.

Keywords: *Aerial mapping, Biomass assessment, Crop scouting, Flight endurance, Precision agriculture, UAV*

Potential Use of Ultrasound as a Repellent for Pulse Beetle (*Callosobruchus chinensis* L) Adults

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ABSTRACT

Pulse crops are cultivated globally for their nutrient-rich seeds and oil production. One of the major challenges of storing seeds is the insect attack on seeds, causing substantial economic losses during post-harvest storage.The pulse beetle, *Callosobruchus chinensis* L is one of the main pests that causes harm to stored pulses, particularly in tropical and subtropical regions. Traditional pest management relies on chemical insecticides, and it is associated with handling risks, residues, resistance development, resurgence, and environmental contamination. Ultrasonic pest repellers are frequently suggested as an alternative solution, but their efficacy in controlling stored pests remains largely uninvestigated. The objective of this study was to investigate the potential of using ultrasound as an insect repellent for controlling *C.chinensis*. The experiment was carried out at Faculty of Agriculture, University of Ruhuna. Two testing trials were conducted, one with an ultrasonic device and one without. Each experimental chamber had a test and an escape chamber, connected by a corridor. For the experiment one, 50 pulse beetles were placed in a test chamber and exposed to ultrasound waves with different frequencies evenly for 30 minutes and each experiment was replicated three times. The test was carried out at eight different frequencies: T1 (control/without ultrasound), T2 (40 kHz), T3 (45 kHz), T4 (50 kHz), T5 (55 kHz), T6 (60 kHz), T7 (65 kHz) and T8 (70 kHz). After 30 minutes, the number of beetles escaped the test chamber was counted. The collected data was analyzed using ANOVA and the number of escaped beetles between the test and the control were compared using Dunnett's test. The results demonstrated that the number of beetles escaped from the test chamber was significantly ($p=0.05$) influenced by all tested frequency ranges (40 kHz -70 kHz) in comparison to the control. Notably, the higher number of beetles escaped was observed as 17.7%, 20.4% and 12.7% at 45 kHz, 50 kHz and 55 kHz frequency respectively compared to others. In the experiment two, a trial was carried out for selected treatments: T1 (control), T3 (45 kHz), T4 (50 kHz) and T5 (55 kHz) to identify the most affective frequency. The findings demonstrated that there was no significant difference between the number of beetles escaped from the test chamber in three frequencies tested. Therefore, it can be concluded that frequency ranges of 45 kHz - 55 kHz can effectively use to repel the pulse beetle in the stored food.

Keywords: *Insect repellent, Non-chemical control, Pulse beetle, Storage pests, Ultrasound repellers*

Comparison of the Growth of In vitro Propagated and Seed Raised Plants of *Dendrocalamus asper* (Giant Bamboo) and Determination of Suitable Geographical Area for Commercial Plantations

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ABSTRACT

Dendrocalamus asper has garnered significant attention due to its versatile characteristics, making it a multipurpose tree. Despite its considerable economic potential, Sri Lanka needs more plantations of this species, primarily due to the need of more awareness and limited availability of planting materials. To select the most suitable method for establishing plantations, it is crucial to compare the growth of in vitro propagated plants (nodal segments from in vitro germinated seedlings cultured on MS medium supplemented with 1.0 mg/L BAP for shoot initiation and half-strength MS medium supplemented with 2.0 mg/L IBA for root initiation) with seed-raised plants in an experimental field. All plants were allowed to grow without addition of any agrochemicals (fertilizer or fungicide) and were maintained at botanic garden, Department of Botany, University of Sri Jayewardenepura for one year. The increment of mean shoot number (6.20±0.35) and shoot length (26.07±0.92 cm) of tissue-cultured plants were significantly higher and increment of mean leaf number (22.47±0.95) was non-significantly higher than seed-raised plants. The comparison of total chlorophyll, chlorophyll a and b contents between these two types of plants over twelve months period in every three months, did not show any significant difference. Although, there was a difference in chlorophyll content in the early stages, it diminished as the plants matured. Two months old in vitro raised plantlets were transferred to twelve different locations (25 plants per location), to identify the most suitable geographical area in Sri Lanka to establish *D. asper* for commercial plantations and found that the Gannoruwa site exhibited the best growth performance, with a mean number of culms per bush of (20.1±0.46), mean culm height increment of (44.2±0.64 cm), and an average of (24.95±0.51) leaves per culm. In vitro propagated plants have demonstrated the most favorable characteristics for plantation growth, particularly in the identified optimal area in Sri Lanka. This serves as a promising indication of the viability of bamboo cultivation in Sri Lanka and exploring in vitro techniques for producing high-quality planting materials will be essential for advancing *D. asper* cultivation in the future.

Keywords: *Dendrocalamus asper, In vitro propagation, Cultivation, Plantation establishment*

Variation of Fine Roots and Yield Attributes of Black Pepper (*Piper nigrum* L.) with Different Types of Support Trees

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ABSTRACT

Black pepper is known as the 'King of the spices' due to its dominant and huge demand. Due to being a vine, pepper requires live or dead support for optimum growth. This research was carried out to study; the variation of fine roots of both support tree and pepper vine, variation of Photosynthetically Active Radiation absorption by pepper vine with the re-growth of support tree canopy after the pruning, and differences of growth and yield attributes of pepper vines under different support trees. *Ceiba pentandra, Thespesia populnea, Erythrina indica* and *Gliricidia sepium* Jacq were used as treatments. Treatments were arranged in a Randomized Complete Block Design with three replicates. Initially, Canopies were removed of all support trees. Data on Photosynthetically Active Radiation interception of treatments were collected at two-week intervals using Line Quantum Sensor. The number of newly initiated shoots (orthotropic and plagiotropic) and flowers were recorded of whole pepper vine at two-week intervals. Fine roots (Roots less than 2 mm in diameter) of both pepper vines and support trees were collected at two-week intervals and the first root data set was collected two weeks after pruning. One-third of the circle around the support tree-pepper vine at a 45cm radius was selected and soil was removed up to 40 cm from the surface. Fine roots of both pepper vine and support tree were collected and total number and length of fine roots were measured. Three months after pruning, data on biomass production of support trees were measured. Biometric data were analyzed using SAS software. From 2nd week to 8th week after pruning, the absorption of Photosynthetically Active Radiation by pepper vine was gradually decreased in all four treatments and average absorption percentage by pepper canopies were 73%, 63%, 57%, and 54% respectively. Total number and length of fine roots of pepper were increased up to 6th week after pruning and they were decreased in 8th week after pruning. Newly initiated orthotropic shoots and spikes of pepper were significantly different (P<0.05) and a higher number of orthotropic shoots and spikes were produced in pepper vines under *Ceiba pentandra*. Leaf biomass production of support trees was significantly different (P<0.05). Support tree pruning at the right time is essential to facilitate optimum light penetration to pepper vines and to reduce fine root development of support trees. Leaves and stem biomass production and the total number of fine roots are lower in *Thespesia populnea* than all other support trees owing to having the highest pepper root length in pepper vines which is under *Thespesia populnea.*

Keywords: *Black pepper, Canopy, Fine roots, Photo-synthetically active radiation, Support tree, Yield attributes*

Technical efficiency of Coconut (*Coccus nucifera*) by Yield Performance in Nagansola Estate Rasnayakapura Region – Kurunegala

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ABSTRACT

Sri Lanka's coconut industry plays a pivotal role in its economy, utilizing vast tracts of agricultural land and contributing significantly to the country's foreign exchange earnings. This study aims to assess the technical efficiency of coconut production in the Rasnayakapura Region of Northwestern province in Sri Lanka, focusing on the Nagansola estate. Data spanning a decade (2013-2022) from 12 fields featuring coconut palms aged 20 to 70 years were analyzed to identify factors influencing technical efficiency. The multiple linear regression model was employed using the R Studio software environment, treating yield as the dependent variable and independent variables such as the age of trees, soil type, the number of trees, the number of nuts per tree, and various labour inputs including weeding, mulching, fertilizer application, watering, drainage maintenance, husk pit management, pest and disease control, nut picking, and transportation to identify factors influencing yield. Based on the regression analysis conducted, a Technical Efficiency Index (TEI) was formulated as a quantifiable metric to evaluate the technical efficiency of coconut production within the Nagansola estate. It utilizes yield as a benchmark for assessing technical efficiency. Results showed that increased nut production per tree and labour inputs for weeding and applying inorganic fertilizer positively influenced yield. Conversely, increases in watering labor, maintenance of drainage, and pest control labor, as well as the presence of older trees (60-70 years), significantly led to a decrease in efficiency, thereby negatively impacting yield. Variables that positively impact TEI suggest that targeted labor allocation in these areas can optimize overall productivity, while those associated with reduced efficiency indicate potential areas of inefficiency or overuse of resources. These findings provide critical insights for improving management strategies, aiming to maximize efficiency and yield in coconut production systems in Sri Lanka.

Keywords: *Coconut plantation, Technical efficiency, Yield performance*

Evaluation of Mutation Variability and Disease Resistance in Sugarcane (*Saccharum* spp. hybrid) Populations Developed through Callus Culture

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ABSTRACT

Sugarcane is a tall-growing monocotyledonous crop of the family Poaceae and the genus *Saccharum*, cultivated in the tropical and subtropical regions of the world. It is used for sugar production and serves as a food and energy source. Sugarcane has been cultivated in Sri Lanka since the 19th century and crop improvement programmes were conducted by the Sugarcane Research Institute (SRI). Sugarcane crossing and breeding programs take a long time period and certain varieties are susceptible to diseases and have low yields. In vitro artificial mutation can effectively eliminate unfavourable characteristics and develop improved crops with novel genetic variability. Gamma rays are widely used for mutation induction to produce sugarcane plants with abiotic stress tolerance, disease resistant and higher cane and sugar yield. Previously, an experiment was conducted in SRI, Sri Lanka, to develop mutated sugarcane plants using gamma irradiations and mutated plants were already established in the field. This study aimed to evaluate the mutation variability, positive and negative effectiveness in cane and sugar yield parameters and also to evaluate the smut disease resistance. Smut is a fungal disease which significantly reduces cane thickness, internodal length and the number of millable canes that invariably affect the final yield. This study facilitated the replacement of poorly performing commercial clones with beneficial mutants. Cane diameter, length, weight and sugar yield components were measured in twelve months old plants derived from each irradiated treatment and they were compared with donor plants. Results indicated that donor plants of SL 98 2118 have significantly produced higher cane and sugar yield parameters than mutated plants. However, no significant variation was observed among SL 98 2087 donor plants and mutated plants. Smut pathogens were artificially inoculated and morphological characters, disease incidence and disease severity were used to assess smut disease resistance. Results revealed that untreated plants were susceptible to smut disease, while gamma-treated plants exhibited resistance, concluding disease resistance lines were developed from the disease susceptible donor plant. Hence, developing mutated plants through gamma irradiation of callus cultures proves to be a successful protocol for development of new hybrid sugarcane varieties with improved characteristics.

Keywords: *Saccharum, Sugarcane, Artificial mutation, Gamma rays, Smut disease resistance*

Comparative Vegetative Growth Performance of Selected Cinnamon (*Cinnamomum verum* J. Presl) Accessions and *Sri Gemunu* and *Sri Wijaya* Varieties

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ABSTRACT

Increasing the number of cinnamon (*Cinnamomum verum* J. Presl) varieties available to farmers is essential for the Ceylon cinnamon industry to produce cinnamon with different chemical compositions to suit the needs of various industries. Identifying accessions with desirable agronomic characteristics, high yield potential, and varied chemical compositions are crucial for developing new varieties. There is a collection of cinnamon accessions with distinct biochemical compositions at University of Ruhuna for this purpose. The objective was to identify potential candidates for selected vegetative growth parameters in comparison to the existing varieties *Sri Gemunu* and *Sri Wijaya*. The experiment was carried out at the Faculty of Agriculture, University of Ruhuna, Sri Lanka. The nine vegetatively propagated accessions (KE-5, GE-11, GK-17, KB-15, RL-15, RL-16, GB-13, KD-4 and PL-2) were grown in the field with two cinnamon varieties *Sri Gemunu* and *Sri Wijaya* using an unbalanced completely randomized design due to plant availability constraints and evaluated 12 months after establishment. Key measurements included plant height and SPAD meter readings, which indicate chlorophyll content and overall plant health. Data were analyzed using ANOVA followed by the Least Significant Difference (LSD) test to determine significant differences between accessions and two existing varieties. In terms of plant height, GE-11 (68.5±23.5cm) was comparable to *Sri Gemunu* (70± 20 cm), while RL-15 (34± 1.97cm), KB-15 (11±4.5cm) and KE-5 (31.2±4.28 cm) were significantly shorter. The highest SPAD meter readings were recorded from GE-11 (52.65±1.58), *Sri Wijaya* (51.56±5.45), KD-4 (48.89±0.73), and KE-5 (48.5±1.44). Readings from KB-15 (43.98±3.25), GB-13 (43.89±2.89), RL-15 (43±2.73), PL-2 (41.06±0.38), GK-17 (41.03±2.92), and *Sri Gemunu* (40.98±2.11) were not significantly different from these. The significantly lowest SPAD reading was recorded from RL-16 (33.9±2.47). According to these results, the performance of GE-11, KD-4, GB-13, PL-2, RL-16, and GK-17 in terms of plant height is comparable to the variety *Sri Gemunu*. Except for RL-16 these accessions recorded similar SPAD meter readings. Therefore, these accessions can proceed with further evaluations for yield and other agronomic characteristics, with the potential for new variety release in the future after further trials.

Keywords: *Cinnamon accessions, Plant height, SPAD meter reading, Sri Gemunu, Sri Wijaya*

Influence of Storage Time of Pollen on Viability and Seed Yield in Chinese Bellflower (*Platycodon grandiflorus*)

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ABSTRACT

Platycodon grandiflorus holds significant export value for Sri Lanka due to its diverse medicinal, landscaping, and edible uses. In F1 hybrid seed production, storing excess pollens allows for timely pollination of the limited number of flowers (around 12) produced by the plant. It frees up skilled laborers for more efficient pollination rather than pollen collection. Knowing the effective pollen storage duration enables pollination with viable pollens, reducing the need for excessive pollination attempts and resources, and ultimately reducing the cost of seed production. The experiment aimed to determine the optimal pollen storage duration for *P. grandiflorus* (SPD 208 variety) at 4°C to maintain pollen viability above 80% and to investigate the relationship between pollen viability and seeds yield. The experiment was carried out using fresh pollens (T1), pollens stored for 2 (T2), 4 (T3), and 6 weeks (T4). Pollen viability was tested using the tetrazolium chloride staining technique at each storage period. The number of seeds per pod, percentage of net dry weight of seeds / fresh weight of pods (Net/Wet percentage), and 1000-seed weight were measured for each treatment. Data analysis revealed that pollen storage time significantly influences pollen viability and gradually decreases with storage time. The number of seeds per pod and mean 1000-seed weight have differed considerably among treatments. The Net/Wet percentage was higher in T1 and T2 than the targeted value of the company. T1 had the highest value in all parameters. A strong positive correlation was observed between pollen viability and the number of seeds per pod. The experiment demonstrated that more than 80% pollen viability can be maintained for up to 6 weeks under 4°C. Prioritizing fresh pollen ensures maximum yield.

Keywords: *F1 hybrid-seeds, Platycodon grandiflorus, Pollination, Tetrazolium chloride*

Optimizing Stigma Receptivity Timing for Enhanced Hybrid Seed Production in *Platycodon grandiflorus FPD 2003 C Variety*

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ABSTRACT

Platycodon grandiflorous, an herbaceous ornamental plant holds a significant value in the floriculture market due to the continuous production of hybrid seeds. Hayleys Quality Seed Company (Pvt) Ltd, Boralanda is a major producer of F1 hybrid seeds of *Platycodon grandiflorous* in Sri Lanka, contributing nearly 30% of its annual production. The stigma's receptivity is crucial for successful hybrid seed production, yet previous studies have focused on earlier varieties. This research aimed to identify the optimal stigma receptivity timing for the new FPD 2003 C variety, developed by breeding FPD 921 G (female) and FPD 927 G (male) parents. The study examined the effects of different pollination timings (3, 4, 5, 6, 7, and 8 Days After Emasculation/ DAE) on seed production with 5 DAE serving as the control based on current practice. Twenty randomly selected plants were allocated to each treatment, and harvesting was conducted 45 days after pollination. Measurements included seed amount per pod, thousand seed weight, empty pod percentage, and the net weight to wet weight percentage. Results indicated significantly high seed counts and 1000 seed weights at 6 and 7 DAE, while 3 DAE exhibited the lowest values. The percentage of empty pods was significantly higher in 3, 4, and 8 DAE treatments. Pollination at 6 to 7 DAE demonstrated superior results in commercial seed production in the *Platycodon grandiflorus* FPD 2003 C variety compared to other treatments. Thus, the study suggests extending the pollination window from the current practice of 5 DAE to 7 DAE, enhancing the flexibility in the breeding program for hybrid seed production.

Keywords*: Hybrid seeds, Platycodon grandiflorus, Pollination timing, Stigma receptivity*

Molecular Diversity Analysis of Selected Sri Lankan Proso Millet (*Panicum miliaceum* L.) Germplasm Using Microsatellite Markers

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ABSTRACT

Despite being underutilized, proso millet (*Panicum miliaceum* L.) is an important, climate-resilient cereal crop with a short growth cycle, cultivated globally for food, feed, and fodder. Understanding the genetic diversity among crop genotypes is essential for the effective utilization of germplasm in genetic improvement efforts. This study aimed to evaluate the genetic diversity of selected 18 proso millet genotypes collected from various regions of the country. These accessions were genotyped using 10 polymorphic simple sequence repeat (SSR) markers to assess molecular diversity and genetic relatedness. Phylogenetic analysis conducted with DARwin 6.0 software revealed significant genetic diversity among the selected genotypes, supported by substantial bootstrap values. The genotypes were grouped into three major clusters. Within Cluster 1, genotypes PM 384, PM 1333, and PM 254 exhibited a near identical genetic relationship. The representation of genetic relatedness was depicted by Principal Coordinates Analysis (PCoA) based on the simple matching dissimilarity index. All accessions collected from Thanamalwila area (PMT 2, P MT 5, PMT 6, PMT 13) expect PMT 12 grouped in one group. In comparison, accessions collected from the Jaffna area are in one group (PMJ 2, PMJ 4, PMK 1) except PMM 1 accession. This pattern suggests a correlation between genetic similarity and geographic proximity. The population structure of the 18 genotypes was analyzed by a Bayesian-based approach (STRUCTURE version 2.0). The analysis revealed a maximum delta K (ΔK) value of 44.81206 for K = 2, indicating two primary clusters. The K value provides the number of distinct genetic groups within the selected genotypes. Based on the probability value (Q value) obtained for maximum ΔK, the 18 proso millet genotypes were evenly distributed between the two clusters. Interestingly, while the population structure was divided into two primary genetic clusters, both the phylogenetic analysis and PCoA suggested a division into three clusters. Geographical region-based clustering was not evident in the population structure revealed by the STRUCTURE analysis. However, the results obtained from PCoA and Neighbor-Joining tree using DARwin software indicate that Sri Lankan proso millet germplasm exhibits a high degree of genetic diversity. A significant correlation was observed, with germplasm collected from the same geographic location showing greater genetic similarity. This study provides a preliminary overview of the genetic makeup of the proso millet genetic resources collection using SSR markers. The findings on genetic diversity and structure offer valuable insights for germplasm management and future proso millet breeding initiatives.

Keywords: *Crop improvement, DARwin software, Phylogenetic analysis, Population structure, Proso millet, SSR markers*

Evaluating the Awareness and Practical Understanding of Crop Genetic Resources among the Agriculture Undergraduates in Sri Lanka

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ABSTRACT

Understanding and conserving crop genetic resources are essential for sustainable agriculture and food security. This study aims to evaluate the awareness and practical understanding of crop genetic resources among agriculture undergraduates in Sri Lanka, identifying gaps and opportunities for enhancing education and training in this vital area. A comprehensive questionnaire was administered to undergraduates from agricultural universities and institutions in Sri Lanka. An online survey of 24 close ended questions was conducted among 341 agricultural undergraduates from nine state universities and other institutes. The questionnaire covered demographics, general knowledge, conservation, utilization, and attitudes toward Crop Genetic Resources (CGR). Data were analyzed by using chi-square test and nonparametric methods. The findings revealed a significantly low level of understanding of CGRs among the students (median=2), A statistically significant difference ($p < 0.05$) was found in the distribution of curriculum coverage, with responses indicating "sometimes" being more common than "rarely," "never," and "often." Only 56% of respondents had attended lectures or seminars on CGRs, highlighting a gap in educational exposure. Awareness of concepts like ex-situ and in-situ conservation was limited, with only 43.7% familiar with these terms. Considering preferred conservation approaches, 27.3% favored coordinating with local farmers for in-situ conservation, 29.3% supported genetic modification, and 26.1% preferred establishing a seed bank. However, 81.2% of respondents believed technology plays a critical to moderate role in CGR conservation. Despite the low awareness, 53.7% expressed high interest in participating in conservation-related fields, indicating a potential for increased engagement with better educational support. When evaluating practical skills, around 43% of students had hands-on experience with CGR-related techniques. The adequacy of laboratory facilities was rated low suggesting a need for improved infrastructure and resources. Moreover, there was a significant interest in additional training and educational resources, with many students requesting more practical sessions and updated curriculum content. The study emphasized the need for improved educational programs and practical training in CGR management for agriculture undergraduates in Sri Lanka to prepare them to contribute to the conservation and utilization of CGRs and to ensure sustainable agricultural practices in the future.

Keywords: *Conservation, Educational programs, Food security, Sustainable agriculture*

Investigation into a High Performing Fertilizer Formulation for Commercial Cultivation of *Livistona rotundifolia*

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ABSTRACT

Livistona (*Livistona rotundifolia*) is a solitary, hermaphrodite palm with high demand as a potted ornamental plant and a cut foliage species in the export market of Sri Lanka. The plant height, leaf area of the character leaves and number of character leaves are major attributes of the export quality of this plant. The fertilizer application is essential to the production of high-quality plants, since the plant traits are well-developed when given enough nutrients. The current study was carried out to find the best formulation of fertilizer that promotes the growth and development of *L. rotundifolia* in the cocopeat medium. The experimental site was set up with three replicates using a Completely Randomized Design. Eight different treatments were designed for this study to investigate the highest performing fertilizer formulation on the growth of young plants including, T1 - control with cocopeat, T2 - 3 g of Osmocote without micronutrients, T3 - 3 g of Osmocote with micronutrients, T4 - 3 g of Smart grow, T5 - 3 g of Basacote, T6 - Biochar + 3 g of NPK mixture, T7 - 8 g of Biofertilizer (*Azospirillum brasilense*, *Azotobacter vinelandii*, *Bacillus megaterium*, and *Pseudomonas fluorescens*) + Biochar + 3 g of NPK mixture, and T8 - 8 g of Biofertilizer + 3 g of NPK mixture (51 g of Epsom salt, 47 g of Triple Superphosphate, 85 g of Sulphate of Potash, 138 g of Urea, and 679 g of Dolomite). Plant height, petiole lengths of first and second leaves, leaf area of first and second leaves, shoot fresh weight and dry weight, root fresh weight and dry weight, root length, number of roots, plumule leaves, leaf buds, number of juvenile leaves with petiole and without petiole, number of character leaves with petiole and without petiole were measured until six-month age growth stage of plant during four-month period, and their mean values were compared for any significant difference by mean separation. As per the findings, T5 exhibited better quality characteristics in commercial production including plant height, leaf area of character leaves along with a higher number of character leaves in comparison to other treatments. Thus, most effective fertilizer treatment for the best growth performance of commercial cultivation of *L. rotundifolia* was 3 g of Basacote (NPK 16:8:12) which was applied once in two months.

Keywords: *Cocopeat, Commercial cultivation, Fertilizer, Growth, Livistona rotundifolia*

Determination of Expansion Variation of Coir Grow Bags against the Aging Duration of Coir Pith

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ABSTRACT

Coconut palm (*Cocos nucifera* L) is a crucial tree for the global economy, with major producers including the Philippines, Indonesia, India, Sri Lanka, and Malaysia. The coconut husk is essential for the coir industry, producing a durable and organic fiber used in various products like floor mats and brushes. The coir industry plays a vital role in Sri Lanka's economy. Coir, extracted from the coconut husk, is used in various products, including coir grow bags, which are increasingly popular in commercial nurseries and home gardens. Coir pith, a byproduct, is used in horticulture, including in the production of grow bags. This study aimed to investigate the impact of coir pith aging on the expansion of coir grow bags, addressing an area with limited existing research. Three types of coir pith samples of non-aged, two-months aged, and four-months aged were collected and processed for the experiment. The samples were crushed, dried to 20% moisture content, and used to make grow bags. Water was applied, and the bags were left for 20 minutes for absorption. The height, width, and length of the bags were measured for each sample type. Coir grow bags were made from the processed coir, and their expansion characteristics were measured. In the experiment, all other factors, such as temperature, humidity, and other conditions, were kept constant. Statistical analysis revealed no significant differences in the height, width, and length of the grow bags with different aging durations of coir pith. These findings suggest that the short-term aging durations of coir pith does not significantly affect the expansion of coir grow bags. This indicates that short-term aged coir can be used without affecting the performance of grow bags. In conclusion, the study provides valuable insights for the coir industry, suggesting that short-term aged coir is suitable for producing grow bags without compromising quality. However, further research is needed to validate these findings under different climatic and environmental conditions.

Keywords: *Age duration, Cocos nucifera, Coir pith, Expansion variation, Grow bags*

Systematic Review of Agro-Environmental Practices and Their Role in Ensuring Future Sustainability in Agriculture

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ABSTRACT

The agro-environment represents a dynamic and complex interactions of agricultural practices, environmental factors, and ecological systems. It encompasses the intricate relationship between human activities in agriculture and the surrounding natural environment, including soil, water, air, biodiversity, and climate. The concept of agro-environment highlights the interconnectedness of agricultural production with environmental sustainability and ecosystem health. The review begins by outlining the fundamental concepts of agro-environmental practices, encompassing a broad spectrum of strategies designed to minimize environmental degradation while optimizing agricultural productivity. Articles were reviewed from the year 2016 through 2024 using PRISMA as a guideline based on the research topic, methodology, data requirements, and practical applications. Relevant scientific works already published on the topic were searched for in the Scopus, Web of Science, ScienceDirect, IEEE, MDPI, and PubMed databases. The evaluation of each practice considers its effects on the environment, economy, and society, demonstrating the diverse character of sustainable agriculture. The review also explores into the complex relationships that exist between ecosystem services and agro-environmental activities. It clarifies the ways in which these approaches support biodiversity preservation, soil health, water conservation, and climate change mitigation. These approaches are invaluable for sustainable agriculture as they help in maintaining a balance of the ecology that is required by promoting ecosystem resilience and optimizing natural resource utilization. Examining the difficulties and obstacles preventing the widespread adoption of agro-environmental techniques is a crucial part of this analysis. Sustainable agricultural development is severely hampered by factors such as low technical expertise, budgetary limitations, inconsistent policies, and sociocultural impediments. Various approaches are explored to help mainstream sustainable practices throughout agricultural landscapes, including stakeholder involvement, legislative reforms, capacity building, and incentive programs. In addition, the review clarifies the socio-economic effects of agro-environmental practices, highlighting how they support rural development-improve farmer livelihoods, and advance food security. Incorporating sustainable practices across the entire agriculture value chain not only improves agricultural resilience towards environmental shocks, but also provides opportunities for value addition and new streams of income. In conclusion, this systematic review underscores the pivotal role of agro-environmental practices in ensuring the future sustainability of agriculture. By embracing and scaling up these practices, stakeholders can forge a path towards a more resilient, productive, and sustainable agricultural system capable of meeting the growing food demands while safeguarding the planet's ecological integrity.

Keywords: *Agro-environmental practices, Agroforestry, Conversion agriculture, Ecosystem resilience, Precision farming*

Potential of Re-using Coco Pellets as a Substrate to Produce Selected Nursery Crops (A Case Study)

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ABSTRACT

Coco pellets provide an ideal substrate to obtain uniform and high-quality vegetable seedling stocks. Currently, approximately 300,000 coco pellets are used for seeding production per month by Cocopel Lanka (Pvt) Ltd. Among them, a considerable amount of coco pellets is discarded due to non-germination of seeds sown without being used for another seeding production process. Considering these aspects, the experiment was conducted to investigate the actual percentage of coco pellets discarded, the germination ability of seeds, when discarded coco pellets are re-used as the substrate, and find an effective method to sterilize the used coco pellets. The overall research contained a survey and three experiments. A survey was carried out to estimate the percentage of discarded coco pellets under each crop. The experiments were conducted to a) compare the differences in physico-chemical characteristics between re-used coco pellets and original coco pellets, b) compare the growth performance of seedlings raised in re-used and original coco pellets and c) find an effective method to sterilize used coco pellets before re-use. According to the survey results, non-germination percentages for green chilli, curry chilli, tomato and brinjal were reported as 7.62, 7.71, 16.49 and 14.66, respectively. The physico-chemical characteristics (water holding capacity, air-filled porosity, bulk density, pH, and EC) of original and re-used coco pellets were significantly different except for the bulk density of coco pellets used for curry chilli, green chilli, brinjal and air-filled porosity of coco pellets used for green chilli and brinjal. However, there was no significant difference in growth performance, except for the stem thickness of chilli (original-1.22± 0.01 mm; re-used-1.25 ± 0.01 mm), tomato (original-2.45 ± 0.05 mm; re-used- 2.68 ± 0.03 mm) and seedling height of tomato (original-14.95 ± 0.37 cm; re-used- 16.85 ± 0.17 cm). Moreover, values for these parameters in re-used coco pellets were higher than in original coco pellets. The application of 100ºC hot water, 1% H_2O_2, 2% H_2O_2, and 3% H_2O_2 to green chilli and 100ºC hot water, 1% H_2O_2, 3% H_2O_2, and 1% $KMnO_4$ to curry chilli were effective to sterilize the used coco pellets before seeding. Thus, the experiment concludes that re-using discarded coco pellets would produce seedlings similar to the seedlings produced in original coco pellets, twelve days after seed sowing. Moreover, sterilization of used coco pellets by 100ºC hot water treatment before seeding is cost effective for green chilli and curry chilli.

Keywords: *Coco pellets, Growth performance, Non-germination, Physico-chemical characteristics, Re-used coco pellet*

Effect of Number of Picks on the Seed Yield and Quality of Hybrid Okra (*Abelmoschus esculantus* L.) Produced under Poly tunnels

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ABSTRACT

The supply of quality hybrid seeds to farmers to enhance their productivity and income is a major issue in Sri Lanka. The majority of the hybrid okra seeds available in Sri Lanka are imports from foreign countries. Therefore, there is a need to develop quality hybrid seed production of promising okra hybrids under local conditions. In seed production, knowing the ideal number of picks that leads to high yield and quality of seeds is important to reduce unnecessary labor and time wastage for the pollination and harvesting. Therefore, this study was conducted to find out the ideal number of picks to maintain high quantity of germinable seed yield of an okra hybrid named CIC OK HY 002 developed by Vegetable Research and Development Unit, CIC Seed Farm, Pelwehera. The experiment was conducted with five treatments in a Randomized Complete Block Design (RCBD) with three replicates. Dried pods from randomly selected twelve plants in three poly tunnels in five picks were used to collect data. Data on the number of germinable seeds per pick, the total number of seeds per pick, the total seed weight per pick, the number of seeds per pod, seed weight per pod, the number of pods per pick, dry pod length at 1st pick, 2nd pick, 3rd pick, 4th pick and 5th pick, and dry pod width at 1st pick, 2nd pick, 3rd pick, 4th pick and 5th pick were used in the analysis. As results showed, pick 1, pick 2, pick 3 and pick 4 are ideal picks for get high quantity of germinable seed yield of promising okra hybrid under local conditions. The reason is the total number of seeds per pick, the number of pods per pick, number of seeds per pod, pod length and width are not significantly different until the 4th pick. The results of this study revealed that the ideal picks to maintain high quantity of germinable seed yield of promising okra hybrid under local conditions were 1st pick, 2nd pick, 3rd pick and 4th pick. In contrast, significantly the lowest number of germinable seeds were obtained from the 5th pick. Considering the germination percentages of seeds in the 1st, 2nd, 3rd, 4th, and 5th picks, okra hybrids should not be harvested after the 4th pick.

Keywords: *Germinable seed yield, Hybrid seeds, Ideal pick number, Okra*

Impact of Hydroponic Models and Growing Media on the Growth and Yield Performance of Lettuce

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ABSTRACT

Soilless cultivation is popular worldwide due to global urbanization, population growth, and space constraints. Hydroponic is a type of soilless growth technique that involves growing plants in a water-based nutrient solution. An experiment was carried out at the District Agricultural Training Centre, Thirunelvelly, Jaffna from the period December 2020 to March 2021 to assess the impact of different hydroponic models and growing media on the growth and yield performance of lettuce. The green lettuce type (RAPIDO 344) was grown using two distinct hydroponic models: a circulating system and a non-circulating system under the 50% shade house. The three growing media used in both systems were sawdust, carbonized husk, and cocopeat. This experiment was laid out in Complete Randomized Design (CRD) with three replicates. Number of leaves, chlorophyll content, newly formed leaves, leaf length, leaf width, plant height, number of branches, plant weight were recorded. Growth and yield attributes were analyzed through SAS software at ($p<0.05$). Lettuce in carbonized husk had the best growth performance in both models. The highest yield of 63.67 g/ plant was observed in the circulating system with carbonized husk. The lowest yield of 31g/plant was observed in Non-circulating sawdust medium. The experiment concluded that lettuce may be effectively grown with great productivity when grown in a circulating system with carbonized husk.

Keywords: *Hydroponic, Soilless, Lettuce, Circulating system, Non-circulating system*

Assessment of Allelopathic Effects of *Conyza bonariensis* L. Extract on the Germination Performance of Tomato and Chili Seeds

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ABSTRACT

Allelopathy refers to the release of biochemicals that impact the growth and development of nearby plants, which can either be beneficial or harmful. *Conyza bonariensis* L., commonly known as "Sudana," is a prevalent exotic weed in Sri Lanka. The main aim of this study is to investigate the allelopathic effects of "Sudana" plant extract on the germination rate and initial growth of chili and tomato seeds under laboratory conditions. "Sudana" Plants were collected, washed and air dried. Then plant parts were dried at 60°C in an oven for 48 hours before grinding into a powdered form. The "Sudana" plant extract was prepared by mixing dry powder of whole plant with distilled water and allowing it to stand for 24 hours. Solutions were then prepared at four different concentration levels (T1-20%, T2-40%, T3-60%, T4-80%) on a weight/ volume basis. Chili and tomato seeds were treated with 1 ml of the respective "Sudana" plant extract twice daily for 14 consecutive days. Each petri dish contained 20 seeds and each treatment was replicated three times. Germination percentage, mean germination time, coefficient of velocity of germination, germination index, average shoot length, average root length, vigor index, average fresh weight, and average dry weight were recorded after 14 days. Based on the analyzed data, tomato seeds treated with the 40% concentration of "Sudana" extract solution exhibited a significantly higher germination index (120.33±3.93), indicating a faster germination rate. Similarly, tomato seedlings treated with the 80% concentration of the extract solution showed significantly greater average dry weight (1.67±5.24 g). Chili seeds treated with the 80% concentration of the extract solution exhibited significantly greater average root length (2.45±0.14 cm) and vigor index (1.68±0.28), indicating a positive influence from the plant extract. Consequently, the research concludes that the allelochemicals from the *Conyza bonariensis* L. plant differently affect both crops, and these effects varies with the concentration of the extract.

Keywords*: Allelopathy, Conyza bonariensis L., Germination, Seedling growth*

Evaluation of Growth and Yield of Two Gherkin (*Cucumis anguria*) Varieties as Affected by Urea and Calcium Nitrate and Skipping 1st Top Dressing

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ABSTRACT

Gherkin (*Cucumis anguria* L) is popularly known as pickling cucumber, which belongs to the family Cucurbitaceae. It is a determinant crop that has a constant vegetative and reproductive phase. Generally, flowering and fruit set start 33-36 days after sowing (DAS). Gherkin requires large quantities of macro and micronutrients for better growth and yield. Generally, before starting the reproductive phase, top dressings are applied three times in vegetative phases 10, 20, and 30 DAS. This study explores the dependency of growth and yield parameters on the first top dressing application time in order to minimise fertiliser wastage, cost, and the source of nitrogen in the top dressing of two gherkin varieties. The research was carried out under field conditions at the Faculty of Agriculture, University of Ruhuna. The experiment was laid out in a split-split plot design with five replications, using two gherkin verities (Chandini –V1 and Kirthi –V2) allocated to the main plots, two top dressing (Urea-F1 and Calcium nitrate- F2) to the sub plots, and two application times of 1st top dressing (10 DAS- A1 and 20 DAS-A2) to the sub –sub plots. Each planting hole was filled with 500 g of compost and inorganic basal dressing before seed sowing. Both vegetative parameters (length of vine (cm), internodal length (cm), number of leaves/vine, leaf area (cm^2) and reproductive parameters (number of days for the first harvest, number of fruits/vine, weight of fruits (g)/vine) were recorded. Data were statistically analysed by using General Linear Model technique (GLM), and means were separated using Duncan's multiple range test at a 5% significant level. The results revealed that there was no significant effect from each individual factor on length of vine, internodal length, leaf area, number of leaves/vine, number of days to 1st harvest, number of fruits/vine, and weight of fruits/vine. There was an interaction effect between fertilizer type and variety by giving the highest number of leaves/vine from the combination F1*V2(77 leaves/vine). Accordingly, it was concluded that, there is no significant impact from the source of nitrogen and application time (skipping of 1st top dressing at 10 DAS) of 1st top dressing on the growth and yield of two gherkin verities except for the interaction effect between F1*V2 on the number of leaves/vine.

Key words: *Calcium nitrate, Gherkin, Growth, Skipping 1st top dressing, Urea, Yield*

Unlocking the Potential of Paclobutrazol in Vegetable Cultivation: A Comprehensive Review Analysis with Special Reference to Tomato (*Solanum lycopersicum*), Chilli (*Capsicum spp*), and Cucumber (*Cucumis sativus*)

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ABSTRACT

Paclobutrazol (PBZ), a plant growth regulator, has garnered significant attention in agriculture due to its multifaceted impacts on plant growth and development. This review aims to provide a comprehensive analysis of PBZ's utilisation in vegetable cultivation, with a specific focus on tomato (*Solanum lycopersicum)*, chilli (*Capsicum spp*.), and cucumber (*Cucumis sativus*). An exhaustive search was performed across multiple electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar. A meticulous literature search was conducted across various databases, utilising keywords such as "paclobutrazol," "vegetable cultivation," "tomato," "chilli," and "cucumber." PBZ is known for its ability to inhibit gibberellin biosynthesis, by inducing a range of physiological changes in plants. The existing studies revealed that PBZ application consistently led to reductions in plant height, internodal length, and leaf area across tomato, chilli, and cucumber plants, while concurrently enhancing leaf greenness and chlorophyll content. This is particularly beneficial in green house and vertical farming systems, where space optimisation is crucial. The compact growth habit induced by PBZ is also advantageous in managing pests and diseases and reduces the need for frequent pruning. Its impact on fruit weight and flower production exhibited variability, with some studies reporting increases and others indicating decreases, alongside similar fluctuations in fruit diameter. PBZ application positively influenced total yield and quality parameters, including fruit firmness, uniformity, and shelf life of fruits. Moreover, PBZ demonstrated efficacy in conferring resistance against fungal diseases and enhancing drought tolerance in these vegetable crops. In terms of safety, PBZ exhibited low dermal toxicity in animals but moderate toxicity in humans, suggesting minimal genotoxic or carcinogenic potential. Further research is warranted to comprehensively elucidate its long-term effects on human health. In conclusion, this review underscores the significant potential of PBZ in optimising vegetable cultivation practices, offering insights into its diverse impacts on growth, yield, and physiological responses of tomato, chilli, and cucumber plants. By adhering to a systematic methodology, this review analysis provides a comprehensive understanding of the current state of knowledge regarding the use of paclobutrazol in vegetable cultivation, thereby informing future research directions and practical applications in agricultural settings.

Keywords: *Chilli, Cucumber, Paclobutrazol, Tomato, Vegetable cultivation*

Evaluation of Selected Rice (*Oryza sativa* L.) Varieties for Early Flowering, Growth and Yield in Low Country Dry Zone of Sri Lanka

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ABSTRACT

Rice (*Oryza sativa* L.) is the main staple food crop in Sri Lanka, playing a crucial role in country's food security which contributing to more than 45% of daily calorie requirement. Flowering stage is a critical phase in the rice growth cycle, as it directly impacts on grain yield and quality attributes. Crop genotypes also play a dominant role in crop production systems. They affect crop productivity by their higher growth and yield potentials. The study was undertaken to evaluate the early flowering, growth performance and yield of four elite breeding lines At 13-1532, At 13-3791, At 18-2223, Bg 11-033 and five rice varieties At 313, At 378, Bg 374, EMF and IR 64 grown under Low country Dry zone condition. The pot experiment was conducted belongs the low country dry zone (6 0130 ̋N and 810.032 ̋S) DL1 agro-ecological region, utilizing a Randomized Complete Block Design (RCBD) with three replicates under the Department of Agriculture (DOA) recommended fertilizer levels. During the experimental period plant height, tiller count, number of leaves, SPAD value per plant as growth parameters, number of days to flower heading, flower opening, peak and closing time of flower opening and number of panicles per plant, panicle length, number of spikelets per panicle, number of filled and unfilled grain count per panicle, thousand grain weight, grain yield, plant and root dry weight per plant and weather parameters during experimental period were recorded. Analyses of variances were performed by using STAR programme for windows version 2.0.1 (IRRI 2014) and means were separated by Least Significant Difference (LSD). Data on various parameters revealed that EMF rice variety showed early flowering ability (average time to start the flower opening was 8.05 AM). Early flower heading (5% heading after 60 days) was recorded in IR 64, At 13- 3791 and Bg 11-033. The tallest variety after ten weeks was Bg 374 (97 cm) and had the highest dry weight (42.7 g plant^{-1}). EMF was the shortest variety (78 cm). EMF variety produced higher number of productive tillers per plant and number of leaves per plant. Rice variety At 378 was shown higher values of SPAD at maximum tillering stage. Number of panicles per plant was higher in the IR 64. The highest thousand grain weight was obtained from Bg 11-033 and At 378 produced higher paddy yield (52.81 g plant^{-1}). Plant height, number of tillers, SPAD and number of panicles per plant significantly correlate on grain yield by 0.93, 0.51, 0.97, 0.57. By using above selected accession in future rice breeding program may have a possibility to build new rice varieties with high yield and early flowering ability to escape the heat stress of environment. .

Keywords: *Flowering time, Growth, Rice, Yield*

Exploring Synergistic Effects of Applying Organic Manures on Growth and Yield of Soybean in the Dry Zone of Sri Lanka

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ABSTRACT

Soybean has been transformed to a cash crop in recent years, with high demand from the food sector reaping substantial economic benefits to the small-scale farmers. The national average is stagnating at 1.57 t ha^{-1}, while nutrient management has identified as the key for maximizing crop yield. With paradigm shift towards organic farming, opened up avenues for improved nutrition through exploring synergy of organic and mineral fertilizers. A field experiment was conducted at the Field Crops Research and Development Institute, Mahailuppallama, to study the impact of organic manure application on the growth and yield of soybean in the dry environments during major and minor seasons of 2022/2023. Sole organic manure and mineral fertilizer were compared with combined organic manure and mineral fertilizer combination and pre-prepared organic foliar application and mineral fertilizer. Non fertilizer added plants were treated as the benchmark. Seed yield of organic manure and mineral fertilizer supplement crop yielded more than 2.0 t ha^{-1} irrespective of the season. In the minor season, the organic and inorganic combination yielded more than 1.0 t ha^{-1} compared to sole organic and sole mineral fertilizer. In major season, yield in general was lower compared to minor season, yet the difference between same combinations remained at 1.0 2.0 t ha^{-1}. The organic foliar application and mineral fertilizer was also yielded similarly to the organic and inorganic combination. Integrating organic manures and mineral fertilizer benefited to crop growth and yield of soybean allowing the farmers to yield above the national average in drier regions of Sri Lanka.

Keywords: *Mineral fertilizer, National average yield, Nutrient management, Organic manure, Seed yield*

Effect of the Selected Agronomic Practices on the Control of Soil Erosion in Cinnamon Lands

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ABSTRACT

Ceylon cinnamon (*Cinnamomum zeylanicum* Blume) is renowned in the areas of the southern province of Sri Lanka. The majority of areas in Matara, Galle carry over 30% of slope are vulnerable on soil erosion and have faced yield reduction. Therefore, there is a need to introduce effective management strategies to control soil erosion. The study was conducted to evaluate the effectiveness of selected agronomic practices on soil erosion control in a steep cinnamon land. Selected four treatments were (T1) Gliricidia stalks installation parallel to the raw (T2) *Arichis pintoi* as a cover crop (T3) making contour bunds with weed debris and (T4) control treatment (no special erosion control method, weeding using the mammoty). A three years old cinnamon land with a 30% average slope at the National Cinnamon Research and Training Center, Thihagoda was selected. Treatments were applied in a RCBD design with 4 replicates. Plot size was 12x19 square feet. The sediments were collected on the runoff plots throughout the three months. Every three-week interval, the soil pH, EC, bulk density, moisture and organic matter were measured. At the end of the research, bark thickness, stem girth and height, fresh and dry bark weight and number of harvestable stems of cinnamon trees were assessed. Significant lower bulk density of 1.32±0.05gcm^{-3} and the highest organic matter percentage of 2.54±0.04 were observed in *Arichis pintoi* treatment. However, significant differences were not observed in other treatments. Moreover, the highest sediment accumulation was observed in the control treatment (48.11 ±17.97 kg), while relatively low sediment accumulation was observed in *Arichis pintoi* (22.19± 8.29 kg) and contour soil bund treatment (24.32±12.45 kg). These results indicated that soil parameters have not been helpfully influenced in the Gliricidia treatment on erosion control and the control treatment has badly influenced. Evident from the results that the *Arichis pintoi* cover crop and contour soil bund treatments can be recommended for cinnamon lands to minimize soil erosion.

Keywords: *Erosion, Runoff, Sediment, Slope, Soil parameters*

Carbon and Nutrient Mineralization in Paddy Soils under Biofilm Biofertilizer Practices

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ABSTRACT

Ecofriendly biofilm biofertilizers (BFBF) are being popularized in paddy (*Oryza sativa* L.) cultivation in Sri Lanka due to their ability to increase crop quality and yield while cutting down chemical fertilizers (CF) use. These outcomes have been attributed to the improved soil microbiota and subsequent restoration of soil-plant-animal-microbial network interactions in agroecosystems with the application of BFBF. However, the effect of BFBF on soil carbon (C) and nutrient mineralization, especially in organic agriculture, has not been studied sufficiently thus far. Therefore, a study was conducted to evaluate this by comparing five treatments i.e. (T1) 100% CF (340 kg NPK/ha, DOA recommendation), (T2) BFBF practice (66% CF + 2.5 L BFBF/ha), (T3) BFBF-based organic practice [500 kg pellet fertilizer (N >1%)/ha + 2.5 L BFBF/ha), (T4) Reference (66% CF), and (T5) Control (no amendments) in a field experiment conducted in agriculture schools in Vavuniya, Angunukolapelessa, and Pelwehera. Five consecutive treatment plots were arranged as a block design in each site. Three field locations acted as replicates. Soil samples were collected at 50% flowering stage of the crop. Soil total phosphorus (P), organic C, and total nitrogen (N) were estimated using colorimetric methods. A leaching column experiment was conducted to examine C, N, and P mineralization throughout a five-month period. Results revealed that the highest mineralization rates of C (53.6 µg C/g soil/week) and N (12.2 µg N/g soil/week) were observed in the BFBF-based organic practice, while the BFBF practice showed the highest mineralization rate of P (1.5 µg P/g soil/week). Moreover, the BFBF-based organic practice showed the highest potentially mineralizable N Pool (31.3 µg N/g soil). In conclusion, the BFBF application has increased the nutrient mineralization of paddy soils. This should be tested further under different soil and climatic conditions, and for evaluating nutrient pool dynamics.

Keywords: *Biostimulants, Rice, Soil nutrient pools*

Biofilm Formation and Mycorrhization with Biofilm Biofertilizer Application in Rice: A Laboratory Simulation Study

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ABSTRACT

Excessive use of chemical fertilizers (CF) for a prolong period has led to degradation of rice (*Oryza sativa* L.) agroecosystems. Biofilm biofertilizers (BFBF) are being popularized in rice cultivation in Sri Lanka due to its ability to increase crop quality and yield while cutting down CF use. It was hypothesized that these outcomes could be attributed to the biofilm formation and mycorrhization in paddy soils that have not been investigated sufficiently thus far under BFBF application. Therefore, a study was designed to test the aforementioned hypothesis by comparing three treatments i.e. (a) 100% CF practice [Yoshida's nutrient medium at NPK rates corresponding to the DOA recommendation (340 kg/ha) + micronutrients], (b) BFBF practice [66% CF + BFBF (2.5 L/ha) + micronutrients], and (c) control (only micronutrients) in a laboratory glass setup, where rice plants were grown in a coconut shell charcoal medium enriched with a soil solution. The experiment was arranged in a Completely Randomized Design, with three replicates for each treatment. Ten days after establishment, samples were taken and analyzed for root-arbuscular mycorrhizal fungi (AMF) colonization, biofilm formation, and leaf chlorophyll content. Results revealed that the percentage colonization of AMF on roots was significantly ($p < 0.05$) higher in the BFBF practice (72%) than the 100% CF practice (50%). In addition, the biofilm mats on plant roots were 1.5 times thicker in the BFBF practice (375 µm) than the CF practice (250 µm). Comparable amounts of leaf chlorophyll content were recorded in both practices. Conclusively, the BFBF application increases the biofilm formation and mycorrhization in rice, possibly contributing to the reported crop quality and yield increases, and cut down of CF use. However, further research is needed to investigate this using advanced methods.

Keywords: *Biostimulants, Paddy, Root-microbe interaction*

Study of Soil Fertility Levels and Mycorrhizal Associations in Clove (*Syzygium aromaticum*) Cultivations in Matale and Kandy Districts

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ABSTRACT

Clove, (*Syzygium aromaticum*) is one of the minor export crops in Sri Lanka. However, the productivity of Clove is lower than the expected amount, and the soil fertility of existing clove fields is not yet properly studied. Therefore, a field study was conducted to evaluate the soil fertility of selected clove fields and availability of mycorrhizal associations, as a potential biological indicator of soil health. Data were collected from 15 clove fields in Matale and Kandy districts. Arbuscular Mycorrhizal (AM) spores were isolated from clove rhizospheres of selected clove trees using wet sieving and decanting methods, while mycorrhizal infection in clove roots was assessed by the 2.5% trypan blue KOH method. Soil chemical and physical properties were determined by using standard laboratory techniques. Additionally, plant data and field data including management practices were collected and analyzed using SPSS version 29.0.1. About 40 % of studied clove fields were steep (>30%), while about 33 % were flat (0-10%) and about 27 % were with moderate slope (10-30%) about 70 % of fields had applied appropriate soil conservation measures. Farmers had never applied inorganic or organic fertilizers and most of them had grown Clove trees under mix cropping systems. The majority of studied clove fields were low in available soil phosphorus (<15 ppm) but had moderate levels of soil total N (0.1-0.2 %) but high K (40- 426 ppm) and soil organic carbon (> 1 %). AM spore density of clove fields ranged from 120- 1040 spores/ kg of soil. Almost all Clove trees had been infected with AM which was confirmed by presence of arbuscules and vesicles in root cells. Pearson's correlation test and Spearman correlation results revealed that there were significant negative correlations between AM spore count and Soil Organic Matter (r=-0.694, p=0.01), Soil Total N% (r= -0.468, p=0.01), Soil pH (r= -0.360, p=0.05) and the soil moisture (r= -0.384, p=0.05) in the studied fields while positive relationship in plant biodiversity in mixed cropping (r=0.398, p=0.01). The study reveals that clove fields had good soil C, K, and N levels with low soil P and healthy with the presence of AM associations even under low soil fertility management practices. Therefore, implementing proper soil fertility management practices, that consider existing mycorrhizal associations in clove-growing soils could further enhance sustainability and productivity of those clove fields.

Keywords: *Clove, Mycorrhizal associations, Soil fertility levels*

Spatial Variability of Soil Organic Matter in Paddy Fields Located in the Polonnaruwa, Colombo, Nuwara Eliya, and Kandy Districts

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ABSTRACT

Soil organic matter (SOM) is an important soil property that determines the land productivity for successful crop production. There is a growing concern to study the temporal and spatial variability of SOM in agricultural ecosystems. Also, it is important to study the basic soil fertility parameters such as SOM content at the field level to address the problems in paddy cultivation and to seek solutions that are specific to each small paddy field. This study assessed the variability of the SOM content in paddy lands in the Polonnaruwa (Dry Zone), Colombo (Wet Zone), Nuwara Eliya (Intermediate Zone and Wet Zone), and Kandy district (Intermediate Zone and Wet Zone), covering the three climatic zones, agro-ecological regions (AERs), soil types, three irrigation systems (major, minor and rainfed), four cropping patterns (rice-rice, rice-fallow, rice-other field crops, and rice -vegetables). Already collected 671 soil samples from the paddy lands within these districts were used for the analysis. Loss on ignition (LOI) method was used to analyze the SOM content. Results revealed that SOM varied in different districts with respect to climatic zones, agro-ecological zones, and soil types in each district. However, among these districts, in the Colombo district, the cropping pattern is affected on the organic matter content of paddy soils. Moreover, irrigation patterns also affect SOM content in the Polonnaruwa and Kandy districts. In the Polonnaruwa and Kandy districts average SOM content in most of the soil samples was 1% - 2% range. In the Nuwara Eliya district, it was 2% - 3% range. The results showed that a satisfactory level of organic matter content (3%) was observed in the paddy soils of the Colombo district. These factors should be considered in fertilizer application and in other management practices in the paddy lands within these districts to improve the soil quality.

Keywords: *Dry zone, Intermediate zone, Loss on ignition, Soil organic matter, Spatial distribution, Wet zone*

Mineralizable (Available) Nitrogen Contents in Vegetable Growing Soils in Badulla District, Sri Lanka

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ABSTRACT

Nitrogen plays a crucial role in crop production as a vital macronutrient, energy-intensive input, and the primary nutrient limited in most agricultural soils. In Department of Agriculture in Sri Lanka, fertilizer recommendations were formulated according to the specific crop requirement. However, the soil has some amount of nitrogen in either inorganic or organic forms. Therefore, it is imperative to consider available soil nitrogen during the formulation of fertilizer recommendations for a given area, rather than solely relying on crop needs. This study aimed to evaluate the spatial and temporal variability of mineralizable nitrogen in selected vegetable-growing soils in the Badulla district. Soil samples were collected from Agrarian Service Centers in Bandarawela (5 locations) and Diyatalawa (5 locations). Samples were collected at two-week intervals for five weeks to study the temporal variability. Eight parameters, including available nitrogen (AN), total nitrogen (TN), soil organic matter (OM), cation exchange capacity (CEC), pH, electrical conductivity (EC), available phosphorus (AP), and extractable potassium (EK), were determined using standard methods. Results are, AN:0.004 - 0.008 (%), TN: 0.112 – 0.238 (%), OM:2.5 - 4.1 (%), CEC:23 – 39.8 ($cmolkg^{-1}$), pH:4.7 -6.75, EC:0.03 – 0.24 ($mScm^{-1}$), AP:79.4 –273.6 (ppm) and EK:101.6 – 410.6 (ppm). No significant temporal variability in available nitrogen was observed over the 10-week period. Regarding the spatial variability, the pooled t-test indicated the level of significance of 0.362. Therefore, it indicates no significant (at 0.05 significant level) difference between the two locations. Further Simple mathematical calculation was done to estimate the baseline level of soil nitrogen**.** Available nitrogen present in each location was calculated as kg per hectare and finally average of those considered as baseline level for the areas. Therefore, the baseline level of available nitrogen in the studied area was 100.49 Kg per hectare. Correlation analysis assessed the significance of relationships between parameters and available nitrogen. It showed level of significance and Pearson correlation value with AN as followed, pH:0.115/ -0.53, EC:0.001/ 0.869, EK:0.011/ 0.759, AP:<0.001/ 0.916, OM:0.303/ 0.363, TN:0.072/ 0.59 and CEC:0.030/ 0.682. Therefore, electrical conductivity, extractable potassium, available phosphorus, and cation exchange capacity were positively correlated with available nitrogen. Additionally, the generated map illustrated the spatial variability of the analyzed soil parameters with the available data. Further, it can be developed with ongoing research.

Key words*: Available nitrogen, Spatial variability, Temporal variability, Mineralizable nitrogen*

Optimization of a Nutrient Mixture to Develop a Nano-based Slow-releasing Fertilizer for Paddy (*Oryza sativa*) by Directing Nanoencapsulation

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ABSTRACT

Paddy is a key component in the agricultural sector in Sri Lanka which immensely contributes to the economy of the country. Fertilizer plays an important role in the paddy cultivation. Zinc (Zn), Magnesium (Mg), and Sulfur (S) are the key nutrients required for paddy growth and quality which are limited in the soil profile. Therefore, a continuous supply of these nutrients during the cultivation time is critical in obtaining a significant yield. Hence, this study aimed to develop a slow-releasing fertilizer using nano-encapsulation to supply Zn, Mg, and S continuously and optimize the concentration levels in soil required for proper growth of paddy. Zn, Mg, and S nanoparticles were synthesized by the green method and encapsulated into coconut shell activated charcoal via using cassava starch as a binding agent and mixed with a compost mixture to obtain a novel fertilizer. The sizes of synthesized ZnO, MgO, and S nanoparticles were measured by the X-ray diffraction analysis (XRD), 20.89 nm, 25.09 nm, and 135.09 nm respectively. Three treatments (T3/12.5 g of novel fertilizer), (T4/25 g of novel fertilizer), and (T5/37.5 g of novel fertilizer) along with blank (T1) and 12.5 g of urea (T2) were introduced for a field trial laid on RCBD design with three replicates on each to optimize the most fitted treatment and solidify the slow-releasing status of synthesized fertilizer mixture. Trial was conducted over 35 days and fertilizer application was done to enrich soil two times on day 0 and 17th without using plant. The nutrient levels were measured initially on the 3rd and 7th days followed by seven days intervals until the 35th day. Results revealed significant differences among treatments ($p<0.05$). All nutrients were significantly increased in all three treatments during these days compared to blank and urea treatments. The highest percentages of Zn, Mg, and S were quantified at 3rd, (1.00±0.172), 35th (0.36±0.02), and 3rd (1.81±0.07) days on T5, T3, and T3 respectively. Furthermore, during the entire period, the percentages of Zn, Mg, and S were obtained in the range of 0.5%, 0.3%, and 1% which were acceptable for paddy cultivation. Hence, this study revealed that the charcoal-based encapsulated method is a valuable concept for developing a slow-releasing fertilizer. Further, feasibility studies will be necessary to conduct field trials to optimize the sufficient concentration levels demanded to progress in a fertilizer mixture that is beneficial to the agriculture sector in the future.

Keywords: *Activated charcoal, Encapsulation, Nutrient, Slow releasing-fertilizer*

Synthesis of Urea-Oxalic Acid Co-Crystal as a Sustained-Release Nitrogen Fertilizer

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ABSTRACT

Urea is a rich source of nitrogen thus it is typically used to make fertilizer. However, it is less effective as a source of nitrogen due to high water solubility, rapid moisture absorption, and urea volatilization. Co-crystallization is a long-lasting technique that can be used to modify the undesirable properties of urea. This study focuses on synthesizing urea-oxalic acid co-crystals which can distribute crop nutrients in a regulated way. The objective of the study was the synthesis of urea-oxalic acid co-crystals, analysis of their structural characteristics through Powder X-ray Diffraction (PXRD), and observing the release behavior of the synthesized co-crystals. The stirring method was utilized for the synthesis of co-crystals. Urea and oxalic acid were thoroughly mixed 2:1 (form I), 2:0.75 (Form II), 2:0.50 (Form III), 2:0.25 (form IV), and 2:0.125 (Form V) weight ratios. Each of these mixtures was dissolved in distilled water by stirring for about 20 minutes at room temperature using a magnetic stirrer. The resultant homogenous solution was filtered using 80 µm Whatman® filter paper. The resulting solution was allowed to evaporate at room temperature (25 °C) which yielded a crystalline salt. SynPthesized samples were re-crystallized for further purification. The nitrogen release behavior of the urea-oxalic acid in water was investigated using a rapid water release test. The quantitative analysis was performed to determine urea concentration using FTIR spectroscopy. The Urea- oxalic acid co-crystals were characterized through Powder X-ray Diffraction for structural alterations. The crystallite size was calculated for major peaks of Urea, and Oxalic acid samples using the Scherrer equation. The nitrogen release behavior of the co-crystals was determined using Attenuated Total Reflectance-Fourier Transform Infrared. According to the PXRD analysis, co-crystal formation was observed in form I and form II. The smallest crystallite size was recorded in form III. No discernible changes in the crystal structures of Forms III, IV, and V were observed. The nitrogen release study suggested that forms I and II release nitrogen slowly compared to the commercially available urea.

Keywords: *Cocrystals, Fertilizer, Oxalic acid, Slow-release, Urea*

Development and Evaluation of Granulated Nitrogen-Enriched Carbon Fertilizer Derived from Sugarcane Bagasse Boiler-Ash

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ABSTRACT

In the sugarcane-based sugar and alcohol industry, various by-products are generated. Among which sugarcane boiler ash stands out as a carbon-rich derivative resulting from the cogeneration process of sugarcane bagasse. Due to its environmental impact, sustainable handling of boiler ash is crucial. This study explores the potential to develop granulated nitrogen-enriched carbon fertilizer using boiler ash. It involved two separate experiments. Initially, granules were fabricated using four binding agents (BA-1: starch, BA-2: molasses, BA-3: methylcellulose, BA-4: vinasse) two carbon activation treatments (with and without) and urea, following Completely Randomized Design (CRD) with four replicates. The top-performing granules were then tested in a potted soil experiment, using Reddish Brown Earth, Alfisol condition under shade house conditions for one month. A Randomized Complete Block Design (RCBD) with three replicates was employed to assess the impact of nitrogen-enriched carbon fertilizer on soil chemical properties. The first experiment showed higher pH, nitrogen (N), and copper (Cu) levels with carbon activated treatment across all four binding agents. BA-2 utilizing without activated carbon exhibited the highest granule strength. Granules of BAs 1, 2, 3, and 4, treated with activated carbon, were subjected to pot-testing, considering their nitrogen content. Pot experimental findings demonstrated significant effects on soil pH, EC, phosphorus, and nitrogen in comparison to controls (zero fertiliser and N: P: K recommendation of SRI). The nitrogen release from the carbon granules resembled that of straight fertilizer treatments. BA-2 utilizing activated carbon, exhibited the highest nitrogen levels after one month, akin to standard fertilizer. The incorporation of nitrogen-enriched carbon granules did not adversely affect soil pH, salinity, or other soil chemical properties. The information gathered from this study is vital for advancing fabrication processes and field experiments with crops are necessary for further understanding the impact on soil properties.

Keywords: *Boiler-ash, Carbon-fertilizers, Sustainable agriculture*

Digital Innovations in the Field of Soil Science in Nepal

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ABSTRACT

Digital innovations refer to the application of technology to develop new goods, services, or procedures that enhance or resolve issues with current systems. These breakthroughs frequently use cutting-edge hardware, software, and data analytics to provide novel solutions or enhance preexisting ones. In order to make informed decisions on soil-based agricultural inputs and management techniques, digital soil maps (DSM), which the Nepal Agricultural Research Council has generated using a machine-learning algorithm, are becoming more and more popular. DSM of Nepal was developed with the objective to deliver soil status of farmers and it was developed by overlaying training data with the environmental covariates and fit to a predictive model. We employed Random Forest model to generate soil properties maps. With a focus on soil attributes like pH levels, soil textures, organic matter content, and nutrient availability, DSM offers insightful data on agro-ecology, topography, soil qualities, and crop adaptability. About 35,000–40,000 people utilize this platform (https:///soil.narc.gov.np) annually, and it has been viewed from over 180 countries. Farmers can optimize their soil resources to increase crop productivity and production, researchers can maximize their resources, extension workers can offer agro-advisory services, policy makers and planners can create effective agricultural programs, and academics can use DSM data as teaching materials. It is highly advised to produce similar technologies in other nations as well.

Keywords: *Agro-advisory, Digital innovation, Digital soil map,*

Mapping Suitability of Soil under Long-term Conventional Tillage in Sindh, Pakistan using Geostatistical Analyst Tool

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ABSTRACT

A Precise calculation of spatial variability of soil properties is vital for the sustainable management of agro-ecosystem and for environment modeling. Conventional tillage practices are the most implemented to prepare the land for cultivating crops in Sindh, Pakistan. A combination of conventional analytical methods and geostatistical methods were used to analyze the spatial variability of physical properties of soils. 100 soil samples were collected in a long-term conventional tilled field through random sampling in the surrounding of Tandojam, District Hyderabad, Sindh. Soil texture, dry bulk density, porosity, moisture content, soil aggregation (small, medium, and large aggregates), and mean weight diameter of the collected soil samples were determined through standard analytical methods. In addition, crop yield, plowing pattern, tillage implement type, and source of irrigation were also recorded. Spatial variation of soil properties were mapped using Ordinary Kriging (OK) interpolation under ArcGIS 10.8 environment. The weights of the soil parameters were assigned through an analytical hierarchy process on Food and Agriculture Organization (FAO) criteria based on the relative importance of soil properties for mapping soil suitability. Results showed the spatial variability of soil bulk density and porosity varied from 1.44 to 1.65 gcm-3 and 38.9 to 44.5%, respectively. Moisture content varied from 9.65 to 10.68%, soil aggregation from 31.79 to 40.25% (large), 30.1 to 32.12% (medium), and 29.31 to 36.36% (small), and soil mean weight diameter from 0.805 to 2.096 mm in long-term conventionally tilled soil. The validation of soil physical properties through semi-variogram models (spherical, stable, exponential, and Gaussian) demonstrated good agreement between predicted and observed values, enhancing confidence in spatial predictions. On the basis of FAO soil quality index, spatial soil suitability map classified that 3.9% of the land was highly suitable for cultivation while 50.98% was moderately suitable, 37.8% was marginally suitable, and 6.9% of the land was not suitable for cultivation under prevailing tillage practices.

Keywords: *Conventional tillage, Ordinary kriging, Soil properties, Spatial distribution, Geostatistical*

Efficacy of Three Selected Semi-Aquatic Plants as Natural Water Quality Treatments in Sri Lanka

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ABSTRACT

The lack of quality water sources due to the presence of pollutants such as heavy metals, pesticides and excess nutrients in water is a major issue in many countries, including Sri Lanka. This may lead to severe health problems, including chronic diseases and developmental issues in both children and adults. Additionally, the pollution severely impacts agriculture and local ecosystems, reducing food security and disrupting biodiversity. Therefore, investigating the potential of semi-aquatic plants for treating water sources provides viable answers in Sri Lanka, where industrial activity, agriculture, and urbanization have made water pollution a major problem. This study based on Diyawanna Oya Sri Lanka, due to its importance in sustaining wildlife and controlling climate, its economic relevance in supplying water for farming and fishing, and its cultural significance in preserving local customs and legacy all make it vital. This research examines the ability of three semi-aquatic plants- *Commelina diffusa*, *Amaranthus viridis*, and *Ipomea aquatica* in phytoremediation for water quality enhancement in Diyawanna Oya, Sri Lanka. The primary objectives encompassed the evaluation of these plants' ability to induce alterations in untreated water. The assessed main physical and chemical parameters of water are, Turbidity, Electrical Conductivity (EC) and pH. Water samples were taken from Diyawanna Oya, which is considered as an Inland Wetland. Plants were grown in basins filled with sampled water and kept for six weeks. Changes in the parameters pertaining to water quality were measured in every two-week intervals. Results were analyzed using Mixed Model for Repeated Measures (MMRM) and Tukey's Test using SAS Studio. The results showed that, *Ipomea aquatica* comparably achieved the highest reduction of Chemical Oxygen Demand from the initial level of 400.0 mg/l to 84.3 mg/l ($P<0.05$) and EC from 184.1 dS/m to 56.05 dS/m ($P<0.05$). EC is progressively declining over the observed time period, whereas, the water's pH was gradually rising. *Commelina diffusa* exhibited the second most notable proficiency in mitigating the aforementioned parameters. In conclusion, *Ipomoea aquatica* has emerged as the most proficient species in reducing water electrical conductivity, while *Commelina diffusa* had exhibited a superior capability in reducing water electrical conductivity compared to *Amaranthus viridis*. *Amaranthus viridis* has emerged as a particularly effective species, demonstrating a significant and rapid decline in water turbidity.

Keywords: *Amaranthus viridis, Commelina diffusa, Ipomea aquatica, Biological oxygen demand, Chemical oxygen demand*

Perception of Vegetable Farmers on Climate Behavior and Potential Impact: A Case of Three Divisional Secretariat Areas in Up-Country Sri Lanka

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ABSTRACT

The impact of climate change on agriculture has been the focus of numerous economic and scientific studies. This attention is driven by the inherent susceptibility of the agricultural sector to climatic uncertainty and its significant role in developing countries, leading to increasing concern for livelihoods and food security. Climate change has the potential to disrupt traditional agricultural practices and supply chain activities, leading to significant loss of production and its impact on food security. Hence, the objectives of this study were to investigate the current climate change adaptation practices among up-country vegetable farmers in Sri Lanka, the farmer-driven factors to adapt, and the barriers they face in adapting. Nuwara Eliya, Badulla, and Bandarawela divisional secretariats were selected as the study area whereas the sampling technique was simple random sampling with a total of 80 up-country vegetable farmers. The interviews were conducted between September and November 2023 and semi-structured questionnaires were used. Descriptive statistics were applied to analyze data. Nineteen percent of total respondents observed changes in rainfall patterns while eighteen percent observed an increase in flood occurrence. Sixty-eight percent of respondents followed adaptation techniques to minimize the impact of climatic extremes. The most commonly applied adaptation measures were switching crop varieties as different crop varieties have various levels of tolerance to extreme weather conditions and extensive use of inputs as in the face of climate stressors, inputs help maintain or even increase yields. One of the major barriers to adaptation for up-country vegetable farmers in Nuwara Eliya, Bandarawela, and Badulla was the lack of access to climate information. In the selected study sample seventy-five percent of respondents lacked adequate awareness about climate change and adaptation. It is crucial to understand the factors influencing farmers' adaptation decisions and to incorporate climate-smart farming methods to manage climate-induced production uncertainty.

Keywords: *Adaptation technique, Climate behavior, Farmer perception*

Assessing the Impact of Climate-Smart Agricultural Techniques on Food Security in Vegetable Farming Households in Bandarawela, Sri Lanka.

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ABSTRACT

Vegetable farming is one of the most prominent farming systems and a major livelihood of the local population in Bandarawela, Sri Lanka. Bandarawela belongs to the upcountry, intermediate zone and it has a unique climate, which is most suitable for cultivating a wide range of vegetable varieties. In recent years, farmers in Bandarawela have faced numerous challenges due to climate change. To address this challenge, Climate Smart Agriculture (CSA) is one of the most suitable and innovative approaches designed to mitigate the impact of climate change. CSA is a combination of adaptation strategies that can enhance climate resilience in the agricultural sector. This research was conducted to investigate the socioeconomic factors that affect the adaptation of CSA practices and identify the influence of the adaptation of CSA practices on household food security of vegetable farming communities. A survey was conducted to gather information from 150 vegetable farmers who were selected randomly by using a simple random sampling method. Adaptation to ten CSA practices developed for upcountry vegetable farming was assessed using a 5-point Likert scale. To measure the household food security status of the farmers Food Consumption Score (FCS) and Household Food Insecurity Access Scale (HFIAS) were used. Mainly descriptive analysis and regression analysis were undertaken to analyse collected data. Results of the descriptive analysis highlighted that only 31% of farmers were adapters for CSA practices while 69% of farmers were non-adopters. Furthermore, the descriptive analysis indicated that, according to the FCS, the majority of the farmers (51%) belong to the Borderline Food Consumption category and according to the HFIAS, the majority of the farmers (49%) belong to the Moderately Food Insecure Category. According to the results of the binary logistic regression analysis, income ($P<0.05$), educational level ($P<0.05$), and land size ($P<0.05$) were identified as socio-economic factors affecting the adaptation level of CSA practices. Based on the results of the multiple regression analysis, adaptation level of CSA practices positively affects the FCS ($P<0.05$) and adaptation of CSA practices negatively affects the HFIAS ($P<0.05$). These results indicate that adaptation of CSA practices positively impacts the household food security of vegetable farmers in Bandarawela. Farmers who highly adapted to CSA practices have a higher level of food security. This research concluded that promoting CSA practices among vegetable farmers can enhance the food security of their households.

Key Words: *Climate smart agriculture, Food security, Vegetable farming*

Assessing the Impact of Vertical Greeneries on Urban Environment Sustainability: A Comparative Analysis in the Colombo Metropolitan Area

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ABSTRACT

Vertical Green Systems (VGS) are important in the development of more resilient and sustainable urban environments, as they combat various environmental problems and contribute to a more dynamic and healthier environment. Research on vertical garden systems has shown how they improve urban sustainability and the quality of life in various ways, including social, economic, and environmental aspects. This study aimed to compare thermal advantages of vertical greening (VGS) based on Colombo district for a hot, humid and sunny conditions in August. By considering plant percentage and directions (100% covered East-West facades,50% covered East-West facades and 75% covered North-South facades) selected suitable VGS were introduced to the selected four sites in Colombo Metropolitan area. To measure the thermal advantage, the study included introducing various fractions of ENVI-met designs to the site with carefully chosen vertical greeneries. In addition, the air temperature at 1.5m was fed to the ENVI-met IDT files, and the actual and predicted temperatures were contrasted. Software was validated with 0.9838R^2 for simulated versus real ground measurements for existing condition. The research results revealed that the existing outdoor temperature was considerably lowered by applying various vertical greenery treatments accordance with its vegetative proportion. In line with research results, the Colombo district is found to reduce its temperature by 1-2.5ºC with the use of different types of VGS. Vertical Greenery Applications at 100% intensity and East -West direction presented the highest temperature reduction while 75% North-South recorded the lowest temperature reduction.

Keywords: *Colombo district, ENVI–met, Thermal benefit, Vertical green systems*

Detecting Rainfall Trend Magnitudes: A Comparison of Statistical Methods

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ABSTRACT

Identification of rainfall trends is very crucial in recognizing the future scenario of rainfall patterns. For this, various statistical methods are used. Among them, linear regression, Mann-Kendal, Sen's slope estimator, innovative trend analysis are widely used methods. However, Mann-Kendal method provides only an indication of a trend, whether it is statistically increasing or decreasing, without the magnitude of the trend. Hence, detecting the trend magnitude is crucial for predicting rainfall scenarios. Different methods have been used by various researchers, but none have compared those for specific conditions. Therefore, this study aims to compare widely using statistical methods for detecting the magnitude of rainfall trends. Three rain gauge sites, namely Ratnapura, Kurunegala, and Anuradhapura, were chosen to represent the three main climatic zones (wet, intermediate, and dry zones) of Sri Lanka. Observed daily rainfall records spanning the past 39 years (1981 – 2019) for these locations were obtained from the Department of Meteorology, Sri Lanka. Linear regression, Sen's slope estimator, and innovative trend analysis methods were compared. The Mann-Kendal method was used to detect the statistical significance of trends. Annual rainfall of 25 years (from 1981 to 2005) was used for trend detection and the subsequent 14 years (from 2006 to 2019) was used for model validation. Using the trend magnitudes from the three methods, rainfall for the next 14 years was predicted. The model fitness was tested by comparing cumulative actual and predicted rainfall values using a 1:1 graph. Further, models were compared from the Root Mean Square Error (RMSE) of predicted rainfall. None of the locations showed a statistically significant trend. However, Kurunegala, located in the intermediate zone of Sri Lanka, exhibits a notable negative trend with an average magnitude of 13.59 mm/year. The model fitness of three methods (R^2) showed a value of 0.99 in all cases, indicating that all methods are equally suitable for trend predictions. In conclusion, Sen's slope estimator is more suitable for predicting positive trends, whereas the innovative trend analysis method is better suited for negative trend predictions. All three tested methods are equally effective for predicting rainfall trends.

Keywords: *Innovative trend, Linear regression, Rainfall trend, Sen's slope, Trend magnitude*

Ethnopharmacological practices of the Santal tribe in the Barind region: a cross –border study

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ABSTRACT

Barind Tract is the largest Pleistocene-era physiographic unit in the Bengal Basin and enriches of different types of flora and fauna having medicinal properties. An Ethnomedicinal field survey was conducted to record the biodiversity of medicinal plants used to cure different kinds of ailments by the Santal community of the Barind tract of Bangladesh and West Bengal, India. During this study, information was collected through unstructured interviewing of local practitioners, home and field visits and focused group discussions. A total of 56 medicinal plants under 30 botanical families were recorded for the treatment of 55 human diseases, whereas, in Bangladesh, it was 61 plants under 39 families to cure 49 diseases. Fabaceae represents the highest number (6 species) of medicinal plants in both the study areas. Leaves were found to be most frequently used plant part owing to 51.78% and 54.38%, respectively, in India and Bangladesh, followed by roots, barks, stems, fruits, and flowers. As much as 43% herbaceous plants were found to be used to treat various diseases in both the study areas. The study revealed that there were lots of variations on ethnomedical knowledge among the Santal community of both the countries in spite of several common uses.

Keywords: *Bangladesh, Barind tract, India, Medicinal plant, Santal tribe*

Bio control potential of *Trichoderma asperellum* against *Stromatinia cepivora* and *Colletotrichum gloeosporioides* causing White Rot and Anthracnose in Onion (*Allium cepa* L.)

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ABSTRACT

The main problem in Sri Lankan onion cultivation is fungal infections including white rot (*Stromatinia cepivora*) and anthracnose (*Colletotrichum gloeosporioides*). *Trichoderma* spp is a fungus widely used to control soil born pathogen like *S. cepivora* and *C. gloeosporioides* in onion. This research aimed to evaluate the antagonistic ability of the *T. asperellum* against the *S. cepivora* and *C. gloeosporioides* in vitro condition. The anthracnose and white rot causing fungal organisms were isolated from symptomatic tissues, collected from different onion fields of Field Crops Research and Development Institute, Mahailuppallama, Sri Lanka and their identity were confirmed according to the macroscopic and microscopic characters. The pure cultures were maintained in PDA for further study. *T. asperellum* used in this research was obtained from the plant pathology laboratory of Field Crops Research and Development institute in Mahailuppallama. The antagonistic test was carried out by a dual culture method on the PDA media with five replicates. A small piece of mycelial disc (5mm diameter) from the growing edge of seven days old fungal culture were taken. *T. asperellum* and phytopathogen was placed on the opposite side of the PDA Petri dishes (90*15 mm), 10 mm from edge of the plate and equal distances apart and plates were incubated for 48 hours. Mycelial growth of *C. gloeosporioides* and *S. cepivora* were measured after 72 hours of growth, with measurements taken in every 24 hours until the entire Petri dish area was covered. Laboratory testing revealed that, the degree of inhibition increased correspondingly as 6.25%, 11.25%, 45% up to 60% in *S. cepivora* and *C. gloeosporioides* got 25% percentage inhibition on third day and increased to 40% inhibition percentage. From our investigation it was concluded that *T. asperellum* as a potential bio fungicide to control anthracnose and white rot disease in onion.

Keywords: *Anthracnose, Colletotrichum gloeosporioides, Onion, Stromatinia cepivora, Trichoderma asperellum, White rot*

Assessment of Thrips Resistance and Growth Performance in Selected Chili (*Capsicum annuum*) Varieties under Yala Season Cultivation

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ABSTRACT

Chili (*Capsicum annuum*), which belongs to the family Solanacea, is a spice essentially used in Sri Lanka. Thrips, mites, and aphids are major pests of this crop, with thrip damage being a significant issue. Leaf curl complex, primarily caused by chili thrips, severely impacts cultivation, especially in the Yala season. They feed on leaf sap, which induces leaves to roll and reduces leaf size. The lack of resistant genotypes against thrips exacerbates this problem. Therefore, this research was developed to evaluate the thrips resistance in five recommended varieties (MICH Hy1, MICH3, KA2, PC1, and GK varieties). Field Experiments were conducted during the Yala season with 30 replicates. Randomized block design was used with plot size of 3.8 m x 3.2 m with 1.2 m between replicate and 0.6m alley between plots giving a total land area of 12.16 m^2. All other agronomic practices (fertilizer application, watering, weeding, disease management) were followed according to the recommendation of the Department of Agriculture. As phenotypic data; plant growth parameters (plant height and canopy width), thrips damage severity index, and yield parameters were evaluated. According to the consistent monitoring of thrips damage severity, MICHHy1 showed significantly higher damage severity, while PC1, MICH3, and KA2 consistently showed significantly lower damage severity. Despite its susceptibility, MICH Hy1 displayed superior growth and yield recovery capabilities. PCR-based molecular techniques can be used to identify plants that are resistant to chili thrips. Genetic traits can be evaluated to study thrips resistance in chili, however due to the lack of suitable SSR markers for genetic studies and a lack of data on them, SSR markers used for thrips resistance in rice (RM515, RM 518, and RM 412 markers) were used in this study to evaluate the thrips resistance in chili. Since rice and chili belongs to two different families; family Gramineae and family Solanaceae respectively, no amplifications were observed. Therefore, it is recommended to develop and design of suitable primers to evaluate the thrips resistance in chili varieties. According to the phenotypic evaluation, MICHHy1 exhibited significantly greater damage severity, however it has a special ability to recover those damages and perform better in terms of growth and yield.

Keywords: *Chilli, Scirtothrips dorsalis, SSR marker, Thrips resistance*

In-vitro Studies on Antifungal Activity of Selected Plant Extracts Against *Curvularia luntana* Causal Organism of Die-Back Disease in Coconut

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ABSTRACT

One of the most common fungi that affect coconut seedlings is *Curvularia luntana*, which causes leaf die-back disease. Although synthetic fungicides are practiced for controlling the disease, it has several drawbacks; such as inefficient control, toxicity, scarcity, and expensiveness. Therefore, natural botanical extracts having antifungal effects may become a more reliable alternative to overcome those drawbacks. The present study was done to test the *in-vitro* antifungal activity of the selected plant extracts against *C, luntana*. The pathogenic fungi were isolated from the seedlings as a pure culture on a PDA medium. The aqueous crude extracts of the ten plants that have been previously identified for antifungal properties were used for the in-vitro test. The antifungal activity was tested by using the poison food technique. The radial growth of the fungal cultures was measured for seven days, and the percentage of inhibition (PI) was calculated. The dilution series including 100%, 75%, 50%, 25%, 10%, and 1% were used with six replicates to determine the most effective concentration for inhibition of fungal growth. According to the PI values, the bulb extract of *Allium sativum* (100%), the leaf extract of *Cinnamomum verum* (93.10%), the juice of *Citrus aurantiifolia* (84.86%), and the rhizome extract of *Curcuma longa* (79.44%), were shown significant inhibition of the growth of *C. luntana* on PDA medium than positive control (Bordeaux mixture 68.89%). The extracts of *Piper nigrum* (67.64%), *Allium cepa* (64.03%), *Azadirachta indica* (61.39%), *Moringa oleifera* (61.11%), *Gliricidia septum* (47.92%), and *Murraya koenigii* (36.67%), showed minimum inhibition of the pathogen. The maximum antifungal potential of all plant extracts was shown at 100% concentration while the effective lowest concentrations were 25% for garlic, 1% for cinnamon and turmeric, and 50% for lime. Our study revealed the antifungal potential of four plant extracts against *C. luntana*, and further study is needed to determine whether these extracts can be applied *in-vivo* to minimize the die-back of coconut leaves.

Keywords: *Botanicals extract, Coconut, Curvularia luntana, Leaf die-back disease, Poison food technique*

Effective Fungicide Spraying Schedule for Management of Potato Late Blight Disease under Inconsistent Weather Conditions in the Upcountry Wet Zone of Nuwara Eliya District

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ABSTRACT

Late blight disease caused by *Phytopthora infestans* is one of the major threats in potato cultivation in the upcountry wet zone in Nuwara Elya district. This disease develops in environments with low temperatures, high relative humidity, and persistent precipitation. It is recommended to apply systemic and contact fungicides on a weekly basis in an alternative manner to control this disease. Farmers in this area fail to adhere to this because the spraying plan has failed to control the disease in the face of unpredictable weather. Thus, the purpose of this study was to determine the best fungicide spraying schedule for controlling the disease under inconsistent weather conditions. Nine fungicide spraying schedules were compared with the unsprayed condition, including spraying only contact fungicide once or twice a week, depending on the amount of rainfall and relative humidity, and spraying contact followed by systemic fungicides once or twice a week in an alternative manner, depending on the amount of rainfall and relative humidity. Potato variety Granola were utilized. Disease severity was recorded once a week using severity scale before spraying. Throughout the growing seasons, rainfall, relative humidity and temperature data was recorded. The weather conditions were more conducive to the late blight development during the Maha seasons than the 2023 Yala season. In the 2022/23 Maha season, two fungicide spraying schedules, namely, spraying of only contact or contact followed by systemic fungicides twice a week demonstrated the significantly lowest disease severity, at 30% and 23%, respectively. In contrast, during 2023/24 Maha season, the significantly lowest disease severity (51%) was recorded with the use of contact fungicide followed by systemic fungicide based on prevailed rainfall condition. Further, this season had a higher frequency of rainy days. It is evident that the yield was low throughout the Maha seasons. During 2023 Yala, all spraying schedules effectively managed the disease with high yield, except the unsprayed state. Under such conditions, a weekly spraying of contact fungicides alone would be sufficient to manage the disease. In unpredictable weather, potato late blight disease can be managed by spraying contact fungicides followed by systemic fungicides in an alternative manner twice a week or in accordance with the predominant pattern of rainfall.

Keywords: *Disease severity, Fungicide, Maha and Yala season, Potato late blight*

Development of Seed Treatment Rate to Control Chilli Damping off caused by *Sclerotium* spp. Using *Trichoderma* Based Bio Formulation

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ABSTRACT

Chilli (*Capsicum annuum*) is globally important for its economic and culinary value, but its cultivation faces significant challenges from damping-off disease primarily caused by soil-borne pathogens. *Sclerotium* spp. is one of the main causal organisms for the damping off. Conventional chemical fungicides, though effective, pose environmental and health risks. As an alternative, biological control using *Trichoderma* spp., known for their antagonistic properties against various plant pathogens, presents a promising solution. However, the efficacy of *Trichoderma* in chilli cultivation in Sri Lanka remains underexplored. This study aims to bridge this gap by investigating *Trichoderma*'s potential as a sustainable biocontrol agent for damping-off disease caused by *Sclerotium* spp. in chilli. A pot experiment was conducted at the Field Crops Research and Development Institute, Mahailluppallama using Completely Randomized Design (CRD) with five treatments, including three different doses of bio pesticide (5 g/ 1 kg seeds, 10 g/ 1 kg seeds, 20 g/ 1 kg seeds) a chemical treatment (Captan® 50% WP), and a water spray control. Pathogen was artificially inoculated to increase disease pressure and trial was repeated twice. Results showed that application of bio pesticide 5 g / 1 kg seeds, exhibited the damping-off disease incidence (40.0% and 32.5% in two trials respectively) compared to the control (97.5% and 90% in two trials respectively). Notably, the application of biopesticide at the rate of 10 g/ 1 kg seeds showed the 30.0% and 32.5% disease incidence and 20 g/ 1 kg seeds treatment rate showed the 27.5% and 30.0% respectively without showing significant difference among different dozes and with the disease incidence of Captan® treatment (42.5% and 35.0%). These results support the use of *Trichoderma* spp. as a substitute for the chemical seed treatment as a viable biocontrol agent, aligning with sustainable agricultural practices. As there were no significant difference between *Trichoderma*-based seed treatments, application of Trichoderma-based bio pesticide at a rate of 5 g per 1 kg of seeds can be used for controlling damping-off disease caused by *Sclerotium* spp.

Keywords: *Chilli, Damping off, Trichoderma*

Livestock, Aquaculture and Food Science

Skipjack Tuna (*Katsuwonus pelamis*) and Yellowfin Tuna (*Thunnus albacares*) Fishery in Sri Lanka; a Comprehensive Analysis

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ABSTRACT

Sri Lanka`s contribution to the world tuna export market is about 2%. Tuna and tuna-like fishes are pivotal biological resources, constituting a significant portion of the offshore fishery in Sri Lanka, and apparent changes of catches are evident. Despite economic significance, catch dynamics of two main tuna species -skipjack tuna (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*) have received little attention in Sri Lanka. Therefore, this study delves into the catch of these two species in Sri Lanka from 2019 to 2022, to generate a better understanding about fishery dynamics of these species. Catch data during 2019 to 2022 showed that, tuna production in Sri Lanka averaged 52% compared to other fish production. Skipjack tuna dominated catches of tuna and tuna like species, comprising 47% in 2019, 48% in 2020, 49% in 2021, and 47% in 2022. Yellowfin tuna followed, with percentages of 41%, 43%, 43%, and 39% for the same years, respectively. The highest skipjack tuna catch rates observed in August from 2020 to 2022. The second highest skipjack tuna catch volumes recorded in March of 2019, 2020, and 2022. These patterns coincide with the migratory behavior of tuna species during the southwestern (May to September) and northeastern (December to February) monsoon seasons, as well as the spawning habits of skipjack tuna throughout the year, with peaks in intensity during November-March and June-July in Indian Ocean. The primary method for skipjack tuna catch is through gillnets, accounting for 50-70% of the total, followed by ring nets contributing 30-40%, while longline fishing represents only about 1%. In 2019, there was a notable increase in yellowfin tuna catch November. In 2020 and 2022, high yellowfin tuna catches were recorded in January and August, while in 2021, it was in January and October. These patterns coincide with the spawning behavior and migratory patterns of yellowfin tuna. Longline fishing dominated yellowfin tuna catches (95-96%), while gillnets (3-4%) and ring nets (1-2%) played minor roles. In conclusion, skipjack and yellowfin tuna dominate Sri Lanka's fish catches, emphasizing the significant impact of seasonal variations and spawning patterns on catch rates. These findings provide baseline information for implementing sustainable management strategies to ensure the preservation of tuna populations while meeting economic demands.

Keywords: *Catch dynamics, Indian Ocean, Skipjack tuna, Sri Lanka, Yellowfin tuna*

Effects of Dilatory Incorporation of *Pouteria campechiana* Meal on the Body Pigmentation and Growth Performances of (*Xiphophorus maculatus*)

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ABSTRACT

The vibrant skin colors of aquatic species are one of the most important commercial traits in driving market demand and economic sustainability for the ornamental fish industry. Mostly the feed ingredients play a pivotal role in fish color development, so ornamental fish farmers add natural or synthetic pigments to enhance the coloration. Among the pigments, carotenoids are more prominent in fish feeds which can be converted into many of the different colors in fish within the body. This preliminary study was performed by using naturally available underutilized canistel fruit using its high carotenoid content in a beneficial way. Canistel (*Pouteria Campechiana* is a tropical evergreen fruit yielding ovoid-shaped yellow fruit. This study examined the body coloration of platy fish (*Xiphophorus maculatus*) with the fact of their widespread popularity in the ornamental fish trade and highly adaptable to captive environments by using the feed with incorporation of dried canistel fruit meal with three dietary incorporations at 3% [T_1], 6% [T_2], and 9% [T_3]. The experiment was conducted for 2.5 months. Feeds were prepared to contain 42% crude protein, 6.3% crude fat, and 3840 kcal/ kg gross energy, then fed to the total number of 360, day-old fry with an initial mean body weight and length of 0.038±0.0008 g and 13.016±0.006 mm were using the experiment in 4 different treatment setups 0% [T_0 – control (no canistel incorporation)], 3% [T_1], 6% [T_2], and 9% [T_3] which each tank contained 30 fries. The feeding rates of the first month and rest were up to 12%, 8% of the body weight respectively. The highest coloration indicated by R value in RGB coloration (Red: 194.5±4.56) was in 9% [T_3] *P. campechiana* incorporated feed compared to all treated groups (Red: 161.60±3.80 ~ 0% [T_0 – control], Red: 151.36±2.98 ~ 3% [T_1], Red: 169.40±3.70 ~ 6% [T_2]). However, when the body weight and length were significantly higher at *X. maculatus* fed on *P. campechiana* incorporate rate 3% [T_1], although no significant impact on body coloration. So, as a cheap pigment source, 9% canistel fruit feed incorporation can be utilized to increment body coloration without suppressing growth although 3% incorporation acts as an additional effect on significant body growth comparing to body coloration. Further research on long-term color retention and optimal balance is recommended.

Keywords: *Body pigmentation, Canistel fruit, Carotenoid, Growth performance, Platy fish*

Optimizing Cryopreservation Thawing Protocols for Enhanced Post-thaw Sperm Motility in Common Carps (*Cyprinus carpio*)

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ABSTRACT

Cryopreservation, initiated with successful bull semen preservation, has expanded to various species, including fish. However, a significant reduction of post-cryopreservation motility of fish sperms has been observed, resulting in a marginal success of a mere 40% to 50% larval production. In standard protocols applied in fish, the thawing temperature (TT), is set at 38 ^{0}C, which is far above the average body or water temperature of tropical habitats. In search of an alternative to improve this using average water temperature 28 ^{0}C in the tropics as the TT may seem logical. This study was therefore conducted to determine suitable TT between 28 ^{0}C and 38 ^{0}C. Before starting the research, the thawing duration at 28 ^{0}C was determined and established at approximately 420 seconds(S). To conduct this investigation, 20 male common carp fish were induced with Gonadotropin-Releasing Hormone at a dosage of 0.2 mL kg^{-1} of body weight. Sperm collection took place 7-hours post-induction, and the collected sperm were quality assessed using standard parameters i.e. motility (M) 85.5%±1.85%, motility duration (MD) 103.6s±4.25s, spermatocrit value 56.25%±1.9%, and sperm cell count 1.5×1011±2.58×1010 ml^{-1}. For each fish, three 5 ml cryo-vials were subjected to thawing conditions at both 38 ^{0}C and 28 ^{0}C. Results indicated that samples thawed at 28 ^{0}C exhibited 100% immotile sperm, while the standard TT showed 69.5% ± 2.46% and 68.9 ± 4.05 seconds average post-thaw M and post-thaw MD. There was a notable temperature difference between 28 ^{0}C and 38 ^{0}C thawed samples for the inner solution, corresponding to 24.7±0.3 ^{0}C and 11.8±0.3 ^{0}C, respectively. At 28 ^{0}C slow thawing rate, possibly leading to ice recrystallization and potential damage to sperm cells, may have resulted in reduced motility. Conversely, at 38 ^{0}C, a rapid thawing rate was observed. To verify accuracy, artificial fertilization was performed using separate vials thawed at different temperatures (38 ^{0}C and 28 ^{0}C). Only the standard TT yielded 42.7%±1.69% larvae production. Recent studies on bull semen cryopreservation have also shown that post-thaw sperm motility increases when using a rapid thawing rate compared to the standard thawing rate. This finding could be explored in future studies on fish sperm cryopreservation. In conclusion, TT of 28 ^{0}C is unsuitable for a successful cryopreservation protocol for 5ml cryo-vials.

Keywords: *Common carp, Cryopreservation, Duration, Thawing, Motility*

Investigation of the Condition Factor and Length-Weight Relationship for Various Fish Species in Samanalawewa Reservoir in Sri Lanka

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ABSTRACT

The Samanalawewa reservoir which is located in the Uda Walawe basin is associated with a major hydroelectricity project, and also provides irrigation for the region, generating a source of livelihood. Locals in the neighborhood are engaged in fishery activities in the Samanalawewa reservoir also. The quality and quantity of fish harvest are key factors that affect their livelihood. Quality of water, availability of the feed for fish and degree of fishing pressure will affect the fish population in the reservoir. Fish species are continuously stocked in inland freshwater reservoirs in Sri Lanka including Samanalawewa, to enhance the culture-based fisheries production. The trophic level of the water source is critical for their survival. The present study aimed at, 1) assessing the current trophic level of samanalawewa reservoir based on the condition factors of selected fish species, and 2) to evaluate the suitability of feed and habitat conditions. The condition factors were investigated for 358 specimens belonging to 10 species (*Ompok ceylonensis*, *Oreochromis mossambicus*, *Cirrhinus cirrhosis*, *Oreochromis niloticus*, *Labeo rohita*, *Catla catla*, *Hypostomus plecostomus*, *Ctenopharyngodon idella*, *Tor khudree*, *Channa striata*), through length-weight relationships. The study was conducted during the period from November 2023 to January, 2024, which is the rainy season for the area, to assess the growth patterns and health status of ten fish species in the Samanalawewa reservoir. The condition factor (K, $100w/l^3$) was calculated to evaluate the overall health of the fish. Most species exhibited lower condition factors ($K < 1$), indicating suboptimal health, except for *Catla catla*, which had a higher condition factor ($K = 3.83 \pm 0.51$), suggesting better health and nutritional status. The growth patterns indicated that most species experienced negative allometric growth patterns, except for *Catla catla*, which showed signs of healthier growth. It can be inferred that the feeding habitat has influenced the healthy growth of fish during this period.

Keywords: *Allometric growth, Condition factor, Fish species, Length-weight relationship, Samanalawewa reservoir*

Determination of Heavy Metals in Main Export Fish in Sri Lanka; Swordfish (*Xiphias gladius*) and Marlin (*Makaira sp.*) Caught from Three Different Locations in the Indian Ocean

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ABSTRACT

Heavy metal contamination is a significant environmental problem in aquatic systems. Heavy metals (HM) are non-essential toxic elements which accumulate through the food chains. The study aims to determine copper (Cu), lead (Pb), cadmium (Cd) and mercury (Hg) concentrations in the muscles of two species of fish being exported from Sri Lanka; *Xiphius gladius* (swordfish) and *Makaira sp.* (marlin) captured in Indian Ocean. This study further emphasizes the human health risk and awareness of heavy metal contamination among fisher communities. Fish samples were collected from Dondra, Mirissa, and Kottegoda harbours in Matara district, Sri Lanka and the fish were caught from three different locations in the Indian Ocean. Muscle samples of both species were digested separately. Digested samples were filtered through glass fiber filter paper, circle (GF/C) Whatman® filter papers and analyzed using atomic absorption spectrophotometry (AAS). Heavy metals were found in fish muscles and heavy metal concentrations were higher in swordfish than marlin for all analyzed metals. The order of accumulated metal concentrations in both species was Hg < Cd < Pb < Cu. Significantly higher ($p < 0.05$) Cu concentration was found in muscles sampled from location 1 for both swordfish (26.4326 ± 1.5063 mg kg^{-1} dry weight) and marlin (13.8656 ± 1.0916 mg kg^{-1} dry weight). The highest mean Pb concentration in swordfish was found at location 3 (3.2883 ± 0.8199 mg kg^{-1} dry weight). The significantly highest mean Cd concentration (0.0111 ± 0.0004 mg kg^{-1} dry weight) was observed at location 1 in swordfish. The Cd concentration of marlin was only detected at locations 1 and 3. The Hg concentrations in swordfish at locations 1 and 2 were not significantly different ($p>0.05$), and at location 3 it was below the detection level while Hg content in marlin fish was below the detection limit at all three locations. Mean concentration levels of Cu, Cd, and Hg were below the standard permissible levels referred by Food and Agriculture Organization (FAO), Food and Drug Administration (FDA), and European Commission (EC) for both fish, species but Pb concentration in muscle tissues of swordfish exceeds the permissible levels. Further analysis is needed to investigate the metal contamination of exported food fish, the influence of geographical distribution, food sources for the accumulation of heavy metals and age-related accumulation.

Keywords: *Food safety, Heavy metals, Makaira sp., Sri Lanka, Xiphius gladius*

Impact of Best Management Practices on Sustainable Shrimp Production: A Case of Shrimp Farms in Chilaw Zone, Sri Lanka

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ABSTRACT

Shrimp industry in the northwestern province of Sri Lanka has experienced rapid expansion, utilizing coastal lagoons and estuaries. While shrimp farming is a lucrative income generator, its growth has been frequently affected by disease outbreaks such as Monodon Baculo Virus (MBV), White Spot Syndrome Virus (WSSV), and Enterocytozoone Hepatopenaei (EHP). The main objective of the study was to assess the current levels of Best Management Practices (BMP) adoption and its influence on shrimp yield in the Chilaw Zone, Sri Lanka, and sub objective is to identify the main challenges and barriers for BMP adoption in shrimp farming industry in the same area. Primary data was collected using a structured questionnaire distributed among 27 randomly selected farmers in the Chilaw zone because those were the currently running farms. Still, the Chilaw zone had three subzones: Thoduwawa/ Iranawila, Ambakandawila, Jayabima/ Wattakkalliya, and a total farm of 83 farms. Focus group discussions were conducted with the participation of the farm owners, farm managers, and farm directors. Data analysis were done by using descriptive anlysing method in SPSS. 09 BMP criteria were considered. There for 55.6% of the farmers were familiar with BMP but 81.5% of them were following best management practices at various levels in Chilaw zone. However, correlation analysis revealed that the relationship between the number of best-managed farms and one-acre harvest yield has a moderate correlation (0.655). Nine criteria were involved in the assessment, and they had a higher contribution to some factors in the harvesting yield. The correlation between feed and feeding management and one-acre harvesting yield was a moderately strong relationship (0.769), with a significant contribution ($p < 0.05$). The research highlights a major challenge, which is a lack of technological infrastructure, knowledge and training among farmers that prevents them from implementing BMPs effectively. A key barrier to the implementation of BMP on farms in the Chilaw Zone was the lack of financial resources. 82% of the farmers were saying that there was a high risk in investing in BMPs due to the uncertain nature of shrimp farming. Present data demonstrate that, BMP adoption among farmers in Chilaw zone is not sufficient, and the present level of BMP adoption is only moderately contributing to the yield.

Keywords: *Best management practices, Chilaw zone, Shrimp industry, Sri Lanka, sustainable*

Insights into Marine Ornamental Fishery Management: A Systematic Literature Review

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ABSTRACT

The increasing demand and economic value of Marine Ornamental Fish (MOFs) have led fishing communities to engage in over exploitation and employ destructive fishing techniques. This creates considerable and long-term damage to coral reefs and associated habitats. Consequently, effective management of MOFs has become increasingly challenging worldwide. Globally, various management approaches are used to manage, monitor, and regulate this industry. However, understanding existing management approaches and their effectiveness is crucial for generating new knowledge and exploring future pathways. Therefore, this Systematic Literature Review (SLR) aims to study the key management challenges, various management approaches in the MOF industry worldwide, along with their effectiveness, and to explore future management prospects. This study was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology. Results revealed that managing the marine ornamental fishery has become quite challenging. This is primarily due to its unique characteristics, such as trading live specimens and the need for specified handling and transport facilities. Moreover, the collection of MOFs creates ecosystem stresses through over exploitation, selected harvesting of juveniles and colored species, and the application of destructive fishing methods. Furthermore, the data-poor situation complicates MOF management by limiting the availability of accurate data. This creates difficulties in making industrial decisions. Most exporting countries lack specific management regimes, legislation, or monitoring programs for MOF. Traditional fisheries management prioritized restrictions on harvest quantity, mainly through the introduction of quota systems. However, this study found that there were many arguments regarding this concept later. Currently, export countries use management approaches such as gear restrictions, right-based fisheries management, total ban or prohibition of important species and the application of limited fishing effort. Import countries require exporters to provide detailed and standardized documentation regarding sustainability certification, fish welfare during harvesting and transportation, and customs procedures. Moreover, numerous studies emphasize importers' use of advanced techniques for cyanide detection to prevent the importation of fish harvested using this substance. The main import countries, such as the United States and countries in the European Union, hold the greatest responsibility. They can shift market demand towards more sustainable marine ornamental fish. This review highlighted future management prospects such as increasing MOF production through breeding, the implementation of specific management regimes for MOFs in both source and import countries and enhancing the power of importers and consumers to demand sustainably harvested fish.

Keywords: *Exporters, Importers, Management challenges, Marine aquarium fish, PRISMA, Sustainable governance*

Effect of Inflation on Ornamental Aquaculture Fish Farming in Gampaha District, Sri Lanka: Challenges and Opportunities Post-COVID-19

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ABSTRACT

The import and export dynamics within the aquaculture and ornamental fish farming sector act as key determinants in the Sri Lankan economy. Following the Covid-19 pandemic, the inflation rate increased by 42.4% from 2021 to 2022 while per capita income decreased by 9.75% during the same period. Moreover, the costs for ornamental fish growers have risen in line with inflation. This research aims to elucidate the extent to which inflation influences the ornamental sector by utilizing both descriptive methodologies in the aforementioned sectors and understanding the present status of the ornamental industry and identifying the problems that have caused these failures in the Gampaha district, Sri Lanka. The study was conducted at the end of the May of 2023 and nine Divisional Secretary's Divisions (DS divisions) covered (Ja Ela, Minuwangoda, Mirigama, Mahara, Attanagalla, Negombo, Wattala, Kelaniya, and Gampaha) where ornamental fish culture is known to be popular. The survey was carried out by interviewing ornamental fish farmers (n=45) using a structured questionnaire. Most of them (86.66%) were identified as small-scale farmers with 75.55% having proficiency with fish culture techniques with hands-on experiences in 24.4%. Considering the interpretation of the dynamic of the ornamental fish industry shows a 40% decline in production in Ja Ela, Minuwangoda, and Attanagalla, while a 20% collapsed in Mahara. Production in the other areas have remained constant. As per the results, *Trichogaster trichopterus, Poecilia sphenops, Cyprinus sp.* showed steady production of 4.54%, 6.06%, and 6.06% respectively. In contrast, there was a decrease in the percentage of production for *Xiphophorus maculatus* (3.03%), *Poecilia reticulata* (4.54%), *Pterophyllum scalare* (6.06%), *Betta splendens* (1.51%), *Carassius auratus* (4.54%), *Danio rerio* (3.03%), *Astronotus ocellatus* (1.51%). However, the intricate interplay between inflation and trade dynamics can be explained by potential drawbacks identified respectively by the study, thus highlighting the problems related to the ornamental fish industry. Here, the priority is considered first level as related to the high feed cost, lack and high price of medicine, disease infection and problems with natural or artificial breeding. Challenges in production and quality assurance and marketing problems are considered second and third level respectively. Finally, other problems as high tax rates and downsizing of ornamental fish collection due to a lack of sellers and problems in aquacultural extension, have negatively affected local ornamental fish growers and ornamental fish exporters. Furthermore, this study will aid businesses in the Gampaha District's ornamental aquaculture industry to counter inflation's trade impact, enhancing economic stability and competitiveness.

Keywords: *Export, Import, Inflation, Ornamental aquaculture, Tax rates*

Reproductive Hormone Dynamics in Catla (*Catla catla*) and Mrigal (*Cirrhinus mrigala*) Carps: Comparative Study

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ABSTRACT

Indian carps play a significant role in the inland fisheries sector of Sri Lanka. They contribute to the enhancement of livelihoods and for food security. Understanding their reproductive physiology to better understand their growth and maturation is crucial for a sustainable carp production. The objectives of the present study were, 1) to optimize an enzyme immunoassay (EIA) for the measurement of serum testosterone and progesterone concentrations; 2) to investigate differences in serum testosterone and progesterone concentrations between immature and mature life stages; 3) to explore the relationship between both serum testosterone, progesterone concentrations, and morphometric attributes and gender in catla and mrigal carps. Heart blood samples (1.0 - 1.5 ml) were obtained from n=60 carps (catla: n=40; mrigal: n=20) harvested from Senanayake Samudraya and Jayanthi Lake, Ampara, Sri Lanka, during the period from July to August 2023. The gender, weight, girth, total length, and fork length were recorded for each fish. Irrespective of the sex, the fish were grouped based on their length (mature: length > 71cm; immature: length= < 71 cm), for ease of analysis. Serum progesterone and testosterone concentrations of each fish were measured after optimizing both assays for the purpose. The optimized EIA for both testosterone and progesterone demonstrated a minimum detection limit of 0.16 ng/ ml while the binding efficiencies were 92.58% (B/B_0) for testosterone and 95.11% (B/B_0) for progesterone. The intra-assay coefficients of variations were recorded as 8.8% (n = 3-4) for testosterone and 14.3% (n = 2-3) for progesterone measurements. Immature carps tested in this study exhibited a higher blood testosterone concentration ($p < 0.05$) than mature carps while there was no difference in serum progesterone concentrations between the mature and immature groups ($p > 0.05$). There was a positive correlation between circulating progesterone and testosterone concentrations in tested fish species ($p < 0.05$). No difference was observed between serum testosterone and progesterone levels between male and female fish, irrespective of their stage of maturity ($p > 0.05$). Circulating testosterone concentrations demonstrated a weak negative correlation with fork length, girth, and weight ($p < 0.05$). There was no relationship between serum progesterone concentration and the body parameters tested ($p < 0.05$). In conclusion, the optimized EIA allowed for the quantification of circulating testosterone and progesterone in catla and mrigal and the analysis of hormonal dynamics provided novel insights into the reproductive hormonal regulation with the growth of these carp species.

Keywords: *Carps, Enzyme immunoassay, Morphometry, Progesterone, Testosterone*

Prevailing Fishing Techniques and Opportunities for Technological Integration in the Marine Fishery Sector of Beruwala Division, Kalutara District, Sri Lanka

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ABSTRACT

Sri Lanka's strategic location in the Indian Ocean offers rich coastal and deep-sea fishing opportunities. By integrating advanced technologies, the country can significantly enhance the potential of its fishery sector, improving sustainability and profitability. This research assesses prevailing fishing techniques and technology usage in the Beruwala fishing harbor, aiming to identify opportunities for integrating new technology into the fishery sector to enhance performance and sustainability. Field observations, interviews with boat owners and fishermen, and Fish Production Statistics from the Department of Fisheries and Aquatic Resources for 2020-2022 were used to gather relevant data from a sample of 230 Inboard Multi-Day (IMUL) boat owners and workers, selected from the 575 registered IMUL boats engaged in high-sea fishing at Beruwala Harbor. Catch data by fish species and gear type were collected for 2020-2022. The number of registered IMUL boats was 537 (2020), 621 (2021), and 451 (2022). Predominant fishing methods included Purse Seine (53.0%), Gillnet (46.03%), and Longline (0.97%). All registered boats are equipped with Vessel Monitoring System transponders and Automatic Identification Systems for vessel tracking and compliance with regulations. None of the observed boats in this study use technology to identify fishing grounds. Fishers still rely on information from other vessels and instinct to find fishing grounds. Satellite technology introduced by the National Aquatic Resources Research and Development Agency in 2022 has yet to gain popularity. Daily fishing operations are logged manually, complicating data analysis due to errors such as illegible handwriting, incomplete records, and data entry mistakes, leading to inaccuracies. More than 75% of boats still use block ice for fish preservation, negatively impacting fish quality upon arrival at the port. Harbor facilities lack advanced storage for post-catch handling and distribution. These findings highlight the urgent need for new technological solutions in various areas. Respondents noted that the lack of advanced fishing ground identification techniques, such as satellite observations, acoustic sonar, and depth sounders, results in longer search times, higher fuel costs, and reduced catch efficiency. Implementing these technologies could significantly improve efficiency and benefit the industry. Moreover, transitioning from small-scale fishing boats to larger vessels with modern technologies like onboard freezers is crucial to improving fish quality and storage efficiency, fostering value addition and export potential. Education and awareness programs are essential to promote technology adoption among fishermen, boosting productivity and sustainability. Proactive policy-making, investments, and government initiatives are necessary to support the fishing industry's technological advancement.

Keywords: *Automatic identification system, Fishing techniques, Technology usage, Vessel monitoring system*

Utilization of Phenolic Antioxidants Extracted from Amla (*Phyllanthus emblica*) Seed for Improved Sensory Properties of Mayonnaise

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ABSTRACT

In response to mounting concerns over sustainability, the food industry is exploring the use of natural phenolic antioxidants derived from fruit by-products as a viable alternative. This study investigated the phytochemical content, antioxidant activity, and *in vivo* acute toxicity of phenolic antioxidants extracted from *Phyllanthus emblica* seeds (PES) and their impact on the sensory properties of mayonnaise. Phenolic antioxidants were extracted using 100% ethyl acetate by ultrasound-assisted method. Total phenolic content (TPC) and total flavonoid content (TFC) were determined using Folin-Ciocalteu's and Aluminium Chloride colorimetric methods respectively. The antioxidant activity of the extract was evaluated using $ABTS^+$ radical scavenging assay and compared with synthetic antioxidant; butylated hydroxytoluene (BHT), at different concentrations (15, 20, 25, 30, and 35 µg/ mL). The acute toxicity of phenolic antioxidants was determined using Zebrafish (*Danio rerio*) embryos exposed at different concentrations (50, 100, 200, 400, and 800 µg/ mL) in 24, 48, 72, and 96 hours of post-fertilization (hpf). The lethal concentration (LC_{50}) and the heartbeat of Zebrafish larvae were determined at 96 hpf. Furthermore, the effect of antioxidants on the sensory properties of mayonnaise were determined at 200 mg/kg dosage. Sensory attributes including appearance, color, taste, odor, texture, and overall acceptability of prepared mayonnaise were assessed using 11-point hedonic scale and compared with control (without added antioxidants) and BHT-added samples. The results indicated that the TPC (g GAE/ kg) and TFC (g QE/ kg) of PES were 23±0 and 16±0 respectively. According to the $ABTS^+$ assay, the half-maximal inhibitory concentration (IC_{50} µg/ mL) of PES was 29±0, which was significantly (p<0.05) lower compared to BHT (63±1). In toxicity assessment, PES exhibited the LC_{50} (µg/mL) of 1189±1, which was significantly (p<0.05) higher than the LC_{50} of BHT (771±2). Both PES and BHT-treated larvae showed a reduction in the heartbeat (bpm) compared to the control larvae (166±1). However, the heartbeat was significantly lower in BHT-treated larvae (144±1) compared to PES-treated larvae (158±0). All sensory attributes of PES-added mayonnaise showed significantly (p<0.05) higher scores than the control and BHT-added mayonnaise. Thus, PES is a promising alternative to synthetic antioxidants in food preparation, due to its increased antioxidant activity, reduced toxicity, and unchanged sensory properties.

Keywords: *Acute toxicity, Antioxidant activity, Phenolic antioxidants, Phyllanthus emblica, Sensory evaluation, Zebrafish study*

Assessment of Glycemic Index and Antioxidant Potential in Newly Cultivated Basmati-Type Rice Varieties from Sri Lanka

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ABSTRACT

Basmati rice, renowned for its distinct aroma and long grains, has gained popularity worldwide, but its nutritional and functional attributes, particularly Glycemic Index (GI) and antioxidant content, in Sri Lankan varieties, are relatively unexplored. This study investigates the GI and antioxidant properties of recently introduced Basmati-type rice varieties in Sri Lanka: CIC-Super-Kernel, CIC-Red-Fragrant, and CIC-Ceylon-Purple-Rice. Chemical composition was analyzed using AOAC methods. Utilizing ISO 26642:2010 methodology, GI values were determined, providing insights into the rice's impact on blood glucose levels. In the GI study, twenty-five healthy volunteers were recruited. After 10 hours of fasting, each study subject was given a 50 g portion of available carbohydrate from reference food (glucose) and on three separate days, test food (rice) containing 50 g of available carbohydrate were served. On each day, fasting and postprandial blood glucose levels were determined over 2 hours, and the incremental area under the curve (IAUC) was calculated. The GI was calculated as the IAUC of the test food divided by the IAUC of the reference food, multiplied by 100. Additionally, the Folin-Ciocalteu reagent method for phenolic content and DPPH (2,2-diphenyl-1-picrylhydrazyl) scavenging assay measured the capacity of these varieties to combat oxidative stress. The statistical analysis involved a one-way analysis of variance and Tukey's multiple range test at a significant level of $P<0.05$. Protein content fell within the range of 11.0±0.2% to 9.7±0.9%, and all the rice varieties exhibited similar fat content due to identical polishing levels (40%). The dietary fiber of these rice varieties ranged from 5.2% to 6.4%. The GI values for the rice were as follows: CIC-Super-Kernel (49±9.4%), CIC-Red-Fragrant (50±3.9%), and CIC-Ceylon-Purple-Rice (51±7.3%). All three rice varieties were classified as low-GI and not significantly different ($P<0.05$) from each other. Significantly higher ($P<0.05$) total phenolic content (39.33±3.89 mg GAE/ g) and antioxidant activity (91.95±0.37%) were obtained in CIC-Red-Fragrant, which provides great health benefits. The findings enhance knowledge of the nutritional profile of Basmati-type rice grown in Sri Lanka and inform dietary choices for optimal health.

Keywords: *Antioxidant, Basmati, Diabetes, Glycemic index, Rice*

Analysis of Physicochemical Properties and Shelf Life of a Milk-Based Drink Incorporated with Mung Bean (*Vigna radiata*), Cowpea (*Vigna unguiculata*), and Finger Millets (*Eleusine coracana*) Sprouts

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ABSTRACT

Sprouts are rich in macro and micronutrients, significantly contributing to a healthy lifestyle. However, the applications of sprouts are very limited unless used in cuisines. This study was carried out to develop a highly nutritious, protein-enriched milk-based beverage incorporated with sprouts of mung bean (*Vigna radiata*), cowpea (*Vigna unguiculata*), and finger millets (*Eleusine coracana*). After germination, the pulp of the sprouts was individually extracted. Following a preliminary trial, the optimal proportion of sprout extracts was determined to be mung bean: cowpea: finger millet as 13%: 40%: 27%. This blend was mixed with milk in varying proportions and pasteurized at 72°C for 15 seconds. The formulation with 50% sprout extraction and 50% cow's milk mixture was selected as the most preferable among the sensory panelists. Both the sample and the control (100% cow's milk) were analyzed to determine the physicochemical and microbiological changes during four weeks of storage under refrigerated conditions. pH, total soluble solids (TSS), titratable acidity (TA), viscosity, and color parameters were analyzed until four weeks of storage at the refrigerator. A significant increase in viscosity was observed after two weeks of storage ($p \leq 0.05$). The pH decreased and the TA increased in both the control and the developed product after two weeks of storage. TSS was lower in the developed sample than the control, and it decreased after two weeks of storage. A significant increase in microbial growth was observed after two weeks of storage ($p \leq 0.05$). The physicochemical properties of the sample showed considerable fluctuations after two weeks of storage due to the degradation of nutrients. The best formulation included ash (0.37±0.002%), crude protein (29.12±1.780%), crude fat (1.53±0.058%), crude fiber (0.07±0.001%), reducing sugar (8.56±0.300%) and vitamin C content (844.72±2.38 ppm). Results indicated that the expected shelf life of the newly developed milk-based sprout drink was estimated to be two weeks under refrigerated conditions.

Keywords: *Milk, Physicochemical properties, Protein, Shelf-life, Sprouts*

Avocado as an Ingredient to Improve the Nutritional, Physicochemical and Sensory Qualities of Chicken Sausages

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ABSTRACT

As a tropical and subtropical fruit, avocado (AV) is highly valued for its excellent nutritional benefits and therefore holds a significant market position. The purpose of this study was to assess how varying levels of AV pulp inclusion (0%, 5%, 10%, and 15%) impact the nutritional, physicochemical, and sensory attributes of chicken sausages. The experiment was conducted using completely randomized design evaluating four treatments (Control: 0% AV, AV5: 5% AV, AV10: 10% AV and AV15: 15% AV pulp). The treatments were analyzed for their proximate composition and physicochemical properties [E.g. pH, cooking yield, cooking loss, moisture retention, texture profiles, folding test characteristics, extract release volume (ERV), juiciness, external and internal colour (CIE L*, a*, and b*)]. Sensory attributes such as toughness, aroma, flavor, juiciness, appearance, surface and internal colours, and overall acceptability were tested using 30-untrained panelists. Increasing levels of AV changed ($P<0.05$) pH to be more acidic. AV improved ($P<0.05$) the cooking yield and reduced the cooking loss. Moisture retention was highest ($P<0.05$) when AV was incorporated at 15%. The hardness significantly decreased ($P<0.05$) with the increased level of AV. Both AV10 and AV15 treatments resulted the best ($P<0.05$) folding test scores. Inclusion of AV at 10% rate resulted the maximum ERV. The juiciness was highest when AV was incorporated at 15% inclusion rate. Inclusion of AV at 10% rate resulted the lowest L* value. Avocado when incorporated at 15% reduced ($P<0.05$) a* value. The internal a* was highest ($P<0.05$) at 10% AV inclusion rate. Increasing the AV inclusion rate from 5% to 10% and 15% increased ($P<0.05$) the internal b*. Of the different sensory attributes tested, only the appearance and the surface and internal colours were affected ($P<0.05$) by the AV inclusion where the 10% AV reported the highest scores ($P<0.05$). The present study concluded that the inclusion of AV at 10% rate performed the best in terms of physicochemical properties. Inclusion of AV in chicken sausages improved the overall sausage quality than the control. Inclusion of AV at its 10% rate attracted the panelists at the highest level. The present study suggests that AV can be incorporated to the chicken sausage at 10% rate demonstrating its potential application as an ingredient in sausage manufacturing industry.

Keywords: *Avocado, Chicken sausage, Crude fiber, Physicochemical properties, Sensory attributes*

Consumption Pattern, Attitudes and Knowledge on Chicken Meat and Eggs Among the University Students: A Study in Sabaragamuwa University of Sri Lanka

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ABSTRACT

The studies investigating chicken meat and egg consumption pattern, attitudes and knowledge among the university student community in Sri Lanka are highly limited. Therefore, the present study aims to investigate the consumption pattern and perspectives towards chicken meat and eggs among the students of Sabaragamuwa University of Sri Lanka. Undergraduates (n=440), representing eight (08) faculties were interviewed using a pre-tested questionnaire. Chi-square analysis and the descriptive statistics were used to analyze the data. Socio-demographic characteristics revealed that the majority of them are female (71.6%), within the age group of 21-24 years (70.9%) and are with either science or math background (29.5% and 27.3%, respectively) depending on the advanced level (A/L) subject stream. Of the non-vegetarians consume poultry meat (68.6%) and eggs (65.1%), chicken (99.3%) and chicken eggs (100%) are the most consumed meat type and egg type, respectively. They mostly prefer to purchase whole chicken (67.6%). Of the students who consume chicken eggs, 23.8% demonstrate an exceptional preference towards the eggs with brown shells. The majority (59.9%) of the participants eat at least 1-2 eggs weekly. From the total 69.8% of the respondents believe that the hormones are used in broiler production. A majority (56.8%) of the respondents believe that the frequent chicken meat consumption during childhood may lead to early sexual maturity in girls. The village chicken eggs were believed to be more nutritious and safer to eat than farm-chicken eggs by 79%. Moreover, 36.8% think that the brown eggs are more nutritious than white eggs and 29.3% reject the fact that the farm chicken eggs available in the market are fertile and carry embryos. Of the total respondents, 44.1% believe that eating chicken eggs daily by a healthy individual causes high blood cholesterol levels and increases the risk of coronary diseases. Except the misinformation 'frequent consumption of chicken during childhood may lead to early sexual maturity in adolescent girls,' no correlation was found between the A/L subject stream and the other misinformation tested. Finally, the present study concluded that misinformation related to chicken meat and eggs do exist among the university students. Therefore, awareness should be increased to eliminate existing misinformation among the students while changing their negative attitudes about broiler chicken meat and eggs.

Keywords: *Attitudes, Chicken, Consumption, Eggs, Meat, Preferences*

Development of Cakes from Composite Blends of 'Gannoruwa Sudu' Sweet Potato (*Ipomoea batatas*) Cultivar Flour and Wheat (*Triticum aestivum* L.): Analysis of Physicochemical and Sensory Properties

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ABSTRACT

Wheat flour (WF) serves as a primary ingredient in bakery goods, yet its importation imposes a significant financial burden due to its unavailability in Sri Lanka. This necessitates the exploration of abundant and viable alternatives to mitigate reliance on wheat imports. Sweet potato (SP) emerges as a promising candidate, given its widespread cultivation and rich carbohydrate content globally. This study was aimed to formulate and evaluate Gannoruwa Sudu (GS) SP cultivar flour (SPF) in cake production. The techno-functional properties, color, and yield of produced flour were evaluated. Four formulas of cakes were developed using the produced flour (A: 100% WF/ Control; B: 60% WF, 40% SPF; C: 50% WF, 50% SPF; D:40% WF, 60% SPF) and their physicochemical and sensory properties were evaluated. The yield of produced SPF was 28.42±0.01%. The bulk density, water absorption capacity, oil absorption capacity, swelling capacity, and foaming capacity of SPF were 0.62±0.01 g cm-3, 139.15±1.18%, 270.00±0.01%, 17.00±0.71 ml, and 0.00±0.00%, respectively. The whiteness of the produced flour (L*:85.74±0.68) was similar to that of wheat flour (L*: 84.88±1.37). Cake formula B with 40% SPF was selected as the most consumer-accepted formula using five-point scale hedonic test. Friedman test results revealed that there was a significant relationship ($p < 0.05$) between consumer acceptability and sensory attributes (appearance, color, aroma, taste, mouth feel, and after taste). The color evaluation results of formula B were as L*: 52.80±0.32, a*:6.05±0.41, and b*:17.97±0.15. The proximate composition of the most consumer-accepted formula contained; moisture: 19.22±0.01%, fat: 28.60±0.01%, crude fiber: 1.14±0.01%, and total ash: 2.43±0.01%. The results of textural properties, hardness, chewiness, gumminess, adhesiveness, springiness, cohesiveness, and resilience of the most consumer-accepted formula were 245.00±0.71 g, 88.50±0.56 mJ, 160.25±0.78 g, 0.16±0.08 mJ, 51.48±0.21 mm, 0.85±0.02 and 0.51±0.01, respectively. The β carotene content, polyphenol content, and IC50 value of DPPH radical scavenging activity of the most consumer-accepted formula (B) were observed as 0.18 mg/100 g, 0.017 GAE/ ml, and 0.171 mg/ ml, respectively. The results of this study revealed that 40% of WF could be replaced with SPF in cake production while value addition to the SP cultivar. Further, it emphasized the potential of using SPF as a replacer for WF in the bakery industry.

Keywords: *Composite flour, Sensory properties, Sweet potato, Techno functional properties*

Determination of Physicochemical Variability and Compliance in Commercially Available Selected Edible Oils (Coconut and Palm oil) in Sri Lanka

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ABSTRACT

The consumption of palm oil (PO), virgin coconut oil (VCO), and loose oil (LO) is widespread among Sri Lankan consumers. Significant variations in physicochemical parameters can be found within the same type of oil at the time of purchase. The purpose of this study was to evaluate the quality attributes of randomly selected oil samples from the Sri Lankan local market at the time of purchase. Thirteen samples, were obtained including four brands of PO, five brands of VCO, and two samples of each loose oil (from coconut oil and palm oil), were procured from different places in the local market. The analysis included measurements of specific gravity, viscosity, color, free fatty acid (FFA) (FFA; AOAC 940:28) content, and peroxide value (PV) (PV; AOAC 965:33) for all oil samples. In the case of PO, PV ranged from 11.13±1.43 meq/ kg to 8.47±0.27 meq/ kg, while FFA ranged from 0.36±0.07% to 0.25±0.03%. Some brands exhibited PV and FFA values compliant with the SLS standards (maximum FFA as palmitic acid: 0.25% and maximum PV: 10 meq/ kg). However, there were no significant differences in color or specific gravity amongst the four brands. For VCO, PV ranged from 4.20±0.31 meq/ kg to 2.27±0.13 meq/ kg, and FFA ranged from 0.30±0.06% to 0.20±0.05%. While some brands met the SLS standard (maximum FFA as lauric acid: 0.2% and maximum PV: 3 meq/ kg), others did not. The five VCO brands did not significantly differ in terms of specific gravity, color, or viscosity. Two samples of each type of loose oil (Coconut Oil and Palm oil) were obtained, and the PV ranging from 7.73±0.06 meq/ kg to 3.8±0.5 meq/ kg for CO and 7.66±0.13 meq/ kg to 3.53±0.17 meq/ kg for PO. FFA values ranged from 0.36±0.06% to 0.33±0.03% for CO and 0.40±0.00% to 0.32±0.06% for PO. Notably, specific gravity, color, and viscosity did not significantly differ among the LO samples. In conclusion, the physicochemical properties of some brands across the three oil types did not comply with SLS standards. Significant variations were observed within brands of the same oil type.

Keywords: *Edible oil, Free fatty acid, Peroxide value, Physicochemical parameters*

Selection of Best Maturity Stage and Cut Shape of Salad Cucumber for the Development of Pickle and Evaluation of its Quality Parameters

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ABSTRACT

Salad cucumber is a cash crop cultivated in protected houses in Sri Lanka which is almost exported as a raw vegetable. In the global context, pickled cucumber is a prominent part of their cuisine. This study aimed to evaluate the best maturity stage and cut shapes of salad cucumbers to develop a pickled cucumber with an Asian spice blend. Both types of cucumbers cut into three different shapes; strips, round slices and slanted slices with 2 mm thickness making six different prototypes; standard strips (SS), standard rounds (SR), standard slants (SL), baby strips (BS), baby rounds (BR) and baby slants (BL). Pepper, fennel seeds and mustard seeds with sugar, salt (1%, 1%, 0.5%, 10%, 2.5% w/v), and vinegar and water were used as other ingredients (70%, 30% v/v). The pickle was packed in sterile glass bottles and pasteurized before sealing and kept two weeks for pickling. Sensory analysis was done using 30 semi-trained panelists with 5-point hedonic scale and data were analyzed with Friedman test using SPSS statistics 25 software. The overall acceptance of prototypes SL and BL was significantly higher ($p<0.05$) than BS while the others did not show any significant difference. There was no any significant difference ($p>0.05$) among any of the samples in aspects of appearance, colour, smell, firmness and pungency. Crunchiness was lowest in BS than all others except SR. However, the highest mean rank values for appearance, smell and pungency were reported in prototype SL (standard slants) thus it was selected as the best cutting shape. The proximate, physico-chemical and shelf-life analysis of the selected product was conducted using standard methods. The pickled cucumber slices showed 90.06±0.90% moisture, 1.73±0.02% ash, 3.75±2.01% crude fats, 0.15±0.01% crude proteins, 0.15±0.23% crude fiber, and 2.84±1.08% carbohydrates in wet weight basis. There was no bacterial, yeast or mold colony formation throughout four months storage under refrigeration condition (4±2 °C) and four weeks storage under ambient temperature (29±2 °C). Moreover, there were no yeast scums on the solution surface of pickles during storage period under both conditions. It can be concluded that the prepared pickled salad cucumber using standard quality fruits cut into slanted slices can be introduced to the market at a consumer acceptable value-added salad cucumber product and it can be stored four months under refrigerated condition.

Key words: *Cut shape, Maturation, Pickle, Proximate composition, Salad cucumber, Shelf-life*

Development of *Musa acuminata* (Ambul) Corm Flour Incorporated Bread: As a Value-Added Food Product

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ABSTRACT

Banana corm is an underground stem rich in stored starch which is generally discarded in banana farming. This study focused on assessing the physicochemical, functional, and sensory properties of flour derived from *Musa acuminata* (Ambul banana) corm and its potential in replacing wheat flour in traditional bread making. Well cleaned corm slices with thickness <1.5 mm was dipped in 0.5% sodium metabisulphite solution for one hour and slices were then dried in both tray dryer and conventional oven at 60 ± 5^0C for 30 minutes and milled to fine powder. Four bread formulas were made from incorporating 20%, 15%, 10% and 5% of banana corm flour with wheat flour. Tray drying had the highest flour recovery percentage (10.64%) with 82.78 of L* values compared to conventional oven drying. Unchanged pH and moisture in flour stored in High Density Polyethylene canister reflected higher flour storage stability of the respective technique. Steroids, terpenoids, coumarins and flavonoids were detected in corm flour. FTIR analysis identified the functional groups such as -OH, -CO, -CH, -OCO, -COC, -COOH and diketone in corm flour. Crude-protein, crude-fat, crude-fiber ash, and potassium content of corm flour was 8.23%, 2.39%, 1.48%, 61.52%, 9.61%, 289.86 mg/100 g, respectively. 15% flour added bread had the highest sensory values for appearance, color, crust color, taste, after taste, bitterness and overall acceptability. The moisture, crude-protein, crude-fat, crude-fiber, ash percentage, potassium content and total phenolic content of 15% corm flour incorporated bread were 36.29%, 17.84%, 5.25%, 12.87%, 3.59%, 82.25 mg/ 100 g and 0.380 GAE mg/ mL, respectively. The zero coliforms and 2.2 and 3.8 ×10^2 (CFU/ g)) of total plate count were detected during two days of shelf life. These standards are well complied with SLS standards for bread. The present study has clearly demonstrated that 15% Ambul banana corm flour can be effectively incorporated with wheat flour to enhance the nutritional and functional properties of traditional bread.

Keywords: *Bread, Corm flour, Musa acuminata (Ambul), Value-added product, Waste utilization*

Development and Quality Evaluation of a Spicy Flavoured Tropical Seed-Based Snack

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ABSTRACT

This research aims to address health hazards associated with artificial colourings and flavourings in snacks by innovatively developing a snack. The main objective of this research was to develop a snack which incorporated natural spices and tropical edible seeds to enhance the health benefits. The new product was a confectionary snack ball consisting of a core and coat. The core was comprised of a blend of sesame and pumpkin seed powder in a 2:1 ratio, with different levels of three different binding agents (T1, T2 and T3) glucose syrup-25%, coconut honey-40% and corn flour-17%, respectively. The texture (hardness) of the core of the snack ball was determined by using the TX 700 texture profile analyser to select the best proportion. T1 was selected as the best propotion (T1 = glucose syrup 25% + sesame seed 50%+ pumpkin seed powder 25%). The coat of snack balls was prepared by using different coating mixtures, which were formulated with three different natural spices: cinnamon, ginger and fennel. The formulas of CCM (Cinnamon coating mixture containing 3% cinnamon) GCM (Ginger coating mixture containing 2% ginger) FCM (Fennel coating mixture containing 0.6% fennel) and CM (Control mixture containing no spices) were developed with dark cooking chocolate. S2 (S2 = T1 + CCM) was selected as the most acceptable snack ball with the desired sensory attributes by using 5 point hedonic scale with 30 untrained panelists. S2 was further analysed for proximate analysis, physicochemical analysis and shelf-life using control sample (S1) (S1 = T1 + CM), and a commercially available artificially flavoured snack ball (CAS). Fibre content (31.07%) was increased and fat, calories and total sugar were not significantly different ($P>0.05$) between the control (S1) and new product (S2) with the addition of natural spices. The new product showed higher protein (13.48%), ash (9.71%) and fibre (31.07%) and lower levels of fat (20.63%), total sugar (22.08%), carbohydrate (51.40%) and calories (445.23%) than a CAS. The results of microbial property analysis of the new product were within the acceptable limit (10 CFU/ ml) until four weeks. Shelf-life of the new product was about one month without adding any preservatives. According to the results, the new product (S2) (S2 = T1 + CCM (cinnamon 3% + dark cooking chocolate 97%)) can be used as an alternative to artificially flavoured products in the market.

Keywords: *Binding agent, Chocolate, Natural spice, Snack ball, Tropical seed*

Evaluation of the Sensorial Attributes and Analysis of the Availability of Antioxidants and the Total Polyphenolic Compounds of Button Mushroom (*Agaricus bisporus*) Based Savory Soup Cream.

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ABSTRACT

In order to combat the rise in non-communicable diseases including diabetes, hyperlipidemia, cardiovascular disease, and kidney problems driven on by diet heavy in sugar, salt, and fat, food consumption globally is shifting toward healthier options. In this product development research, a savory soup cream was produced based on white button mushroom (*Agaricus bisporus*) as the main ingredient and white pepper powder, garlic, red onions, corn flour, soy lecithin, pasteurized cow milk, salt, and palm oil as supplement materials, along with soy lecithin and sodium metabisulphite (SMS) as an emulsifying and preservation agent, respectively. The main objective of the research was to formulate a high-nutritious soup cream based on button mushrooms to cater the fast-food requirement of the commercial market. The best product formulation with the highest consumer acceptance was selected according to the sensory attributes, followed by a three-step sensory evaluation employing a sensory panel (n = 60), and the sensory data was analyzed using the Friedman test and Mann-Whitney U test in the Minitab'19 statistical software package. The formulation that scored the highest value for the sensory parameters; appearance, aroma, colour, taste, and overall acceptability was finalized from the final sensory evaluation ($\alpha = 0.05$). The proximate composition of the selected formulation is 79.3 ± 0.1 % moisture, 27.0 ± 0.3 % total carbohydrates, 2.1 ± 0.1 % crude protein, 2.6 ± 0.3 % crude fiber, 8.9 ± 0.1 % total fat, and 4.3 ± 0.1 % total ash, respectively. A 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay was performed to find out the antioxidant availability, and in the sensorially selected best product, the mean value of half maximal inhibitory concentration (IC_{50}) was recorded as 59.6± 0.8 mg/ml. The total polyphenolic concentration (TPC) of the product was calculated as 1.2±0.1 mg GAE/ g accordingly. The formulated mushroom savory soup cream has been endorsed as a nourishing food recipe full of antioxidants and polyphenolic compounds. This formulation represents a health-beneficial food innovation in the niche market, offering a superior alternative to junk food.

Keywords: *Agaricus bisporus, Antioxidants, Savory soup cream, Sensory evaluation, Total polyphenol*

Determination of Quality Analysis of Value-added Tea Combined with Blue Pea (*Clitoria ternatea*) and Tropical Fruits

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ABSTRACT

Tea, one of the most consumed beverages globally, holds a significant cultural, economic, and health – related role in various societies. In recent, both caffeine and caffeine-free teas are widely available in the market, catering to consumer preference and needs. The growing demand for caffeine – free tea is increased due to the consumer awareness of its potential health benefits. This research aimed to develop a novel value – added flavoured tea by incorporating *Clitoria ternatea* and tropical fruits, followed by evaluating its sensory attributes and quality. Teas were created by combining dehydrated *Clitoria ternatea* flowers (BPF) and locally available fruits in various ratios. Lime and pineapple that had been dehydrated were used to naturally flavour the tea. Dehydrated fruits (DF) were changed as 0.7% (B_1D_1), 1.3% (B_1D_2), 1.9% (B_1D_3) and 2.3% (B_1D_4) and dehydrated *Clitoria ternatea* flowers remained as constant (0.5%) in each treatment. Individual sensory evaluations were conducted on both fruit types with a control sample using 30 non-trained panelists with a 5-point hedonic scale. In all fruit types, B_1D_1 (0.7% DF + 0.5% BPF) were selected most acceptable level with the desired sensory attributes. Selected samples (pineapple with BPF / B_1P_1, lime with BPF/B_1L_1) were stored in air tight containers in room temperature, total phenolic content (TPC), total flavonoid content (TFC), DPPH radical activity, proximate analysis and shelf life were determined and compared with market available BPF tea. Moisture content was tested throughout the month of the period and B_1P_1 showed (1.3466^{b}±0.055 mg QE/ 100g) highest TFC while, B_1L_1 (0.5400^{c}±0.026 mg QE/ 100 g) performed lower value when comparing both. B_1L_1 (9.7367^{a} ±0.53 mg GAE/ 100 g) showed the highest TPC while B_1P_1 performed (7.9233^{b} ±0.34 mg GAE/ 100 g). B_1P_1 (85.113^{a}±6.01%) presented the highest Radical Scavenging Activity and others performed the lowest values. Moisture content in B_1P_1 (11.366^{b}± 0.416 %) performed the lowest moisture and B_1L_1 performed (13.300^{a}±0.360 %) when comparing both. During the two month of storage period, the selected samples showed zero presence of yeast and mould count. In the fourth week, a control sample showed colonies (7×10^{4}CFU). Based on the results presented in this research, the newly developed value - added tea demonstrates superior quality and maintains its integrity and effectiveness for two-month shelf life, confirming its viability and excellence in the market.

Keywords: *Antioxidant activity, Blue butterfly pea flower, Dehydrated fruits, Sensory analysis, Tea blend*

Effect of Fat Level on the Thermal Process Time of UHT Processed Coconut Milk

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ABSTRACT

Coconut milk is a creamy liquid extracted from the fresh kernel of coconut (*Cocos nucifera* L.) and it is used to produce various products with varying fat levels according to their intended use. Ultra-High Temperature (UHT) treatment is a commonly used method to increase the shelf life while assuring safety and quality of coconut milk. Processing conditions are crucial to assure the food safety requirements of UHT processed products. Even though UHT processing is well-established for dairy milk processing, it has not been well defined for coconut milk with different compositions. Therefore, this study aimed to find the effect of fat level on the thermal process time of UHT processed coconut milk. Coconut milk samples with different fat levels (18%, 24%, and 30%) were collected from industries to identify their rheological behavior with temperature (30-90^{o}C). Then the effect of fat level of coconut milk on the holding time of direct and indirect UHT treatments were determined by using thermal expansion and the mass expansion. Furthermore, key quality parameters including pH, total soluble solids, viscosity, density and color were compared between raw and UHT processed coconut milk having different fat levels. Microscopic study was conducted to identify changes of fat globules after the UHT treatment. There were significant differences ($p<0.05$) between viscosity, density and specific volume of coconut milk with fat level and temperature. Lowest viscosities (18%: 11.72±0.09, 24%: 13.14±0.14, 30%: 19.91±0.09) of coconut milk with different fat levels were identified at 70^{o}C in raw coconut milk. According to the microscopic analysis, the viscosity of the UHT processed coconut milk was significantly increased with simultaneous aggregation of fat globule. However, the perceivable browning effect was increased with increased fat level after the UHT treatment. There was no significant effect of fat level on the holding time and F_0 value in direct and indirect UHT methods. Nevertheless, a more pronounced impact of fat level on mass flow rate in holding tube was observed in direct UHT system compared to the indirect UHT system, even though the fat level had no significant impact on thermal process time. Hence, same ingestion flow rates can be applied to coconut milk regardless of their fat level without any adjustments during direct and indirect UHT processing.

***Keywords**: Coconut milk, Fat level, Process time, Rheology*

Economically Efficient and Bioactive Food Ingredient of Dwarf Cavendish (*Musa acuminata AAA)* Banana Peel: The Potential Food Applications

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ABSTRACT

Dwarf-cavendish banana (*Musa acuminata AAA*) is a popular Cavendish banana variety all around the world which is most abundantly grown in the wet zone of Sri Lanka, especially in Sabaragamuwa province, reported for high post-harvest losses due to a short climacteric phase. The value addition of its mature, unripe stage can be considered as an economically efficient use of agricultural harvest. The weight of raw banana peel is approximately about 25-30 % from total fruit weight which is considered as an organic waste. This study explores the bioactivity and potential applications of banana peel as a food ingredient to increase its utilization. The raw, mature Dwarf-cavendish banana peels were separated, dried, and powdered; the banana pulp recorded a brix value of 6.77 ±0.03 %. Browning of the banana peel is a challenge which was mitigated by dipping in a 5 % (w/v) citric acid before drying. Phytochemical analysis of ethanolic extracts of banana peel powder identified the presence of flavonoids. Steroids or tannins were not identified. The crude fiber, ash, and moisture content of banana peel powder was 17.30 ±0.00%, 9.24 ±0.00 % and 7.92 ±0.21 % respectively in dry basis. The total phenolic content of the water extract of peel powder was 0.44 mg GAE/ g, The antioxidant activity of the water extract of peel powder was IC_{50} value of 3.12 ppm. The potassium content of peel powder and banana flour were 0.361 mg/ g and 2.628 mg/ g, respectively. FTIR analysis identified the presence of diketones, carboxylic groups, isopropyl groups, alkanes, alkyl halides, and alcoholic hydroxyl in banana peel powder as important functional groups to ensure the phytochemical properties. Initial pH value and moisture content were 6.53 ±0.06 and 6.92 ±0.21% (dry basis), respectively. Banana peel powder can be stored in air-tight zip lock bags without significant deviations in pH and moisture content for 10 weeks of the research period at room temperature. The study demonstrated the potential of banana peel as a bioactive ingredient in food applications. Banana flour cookies incorporated with 30 % banana peel flour indicated a high fiber content of 7.85 ±0.26 % in dry basis. Incorporating 5 % of banana peel powder in chocolate confectionaries exhibited acceptable sensory properties. Accordingly, Dwarf-cavendish banana peel powder can be utilized as a functional and bioactive ingredient for different food processing applications and suggests further studies in fast-food enrichment and development of edible packaging.

Keywords: *Banana peel, Bioactivity, Dwarf cavendish banana, Food ingredient*

Development of a Defatted Coconut Flour Based Dried Herbal Porridge Powder for Lower Glycemic Index (GI) Value

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ABSTRACT

Defatted coconut flour, also known as coconut residue, is a ground powder obtained after removing oil from coconut meat through drying, expelling, or extracting processes. It serves as a food-grade raw material rich in protein, fiber, and low-carbohydrate content, making it suitable for gluten-free diets. This study aimed to explore the integration of defatted coconut flour - for the development of herbal porridge. Sensory evaluations were conducted by varying the ratios of skim milk derived from coconut residue to water (Treatment 1-1:3, Treatment 2-1:4, Treatment 3-1:5) to determine the optimal blend. The selected ratio was processed using both spray drying and oven drying methods to produce an instant premix. The premix was prepared by diluting oven-dried porridge powder with water at these ratios: T1-1 g powder to 6 ml water and T2-1 g powder to 12 ml water. For the spray-dried porridge powder, the dilution ratios were: T3-1 g powder to 12 ml water and T4-1 g powder to 18 ml water. Nutritional composition, physicochemical properties, and *in-vitro* Glycemic Index analysis of the final product were analyzed. Based on sensory evaluations, the coconut residue: water ratio of 1:4 (T2) demonstrated superior attributes, including appearance, odor, and overall acceptability, compared to other treatments. Oven-dried porridge exhibited the most favorable sensory attributes, leading to the selection of the 1g:6 ml (T1) ratio for further investigations. Significant differences in flour properties were observed between the two drying methods, with oven-dried porridge displaying higher values for parameters such as bulk and tapped density, water and oil absorption capacity, wettability, rehydration ratio, and solubility. Notably, oven-dried porridge exhibited values of 0.72 ± 0.01, 0.77 ± 0.01, 78.15 ± 0.65, 56.30 ± 0.31, 77.67 ± 2.52, 2.63 ± 0.51, and 2.79 ± 0.06 for these respective parameters. The proximate analysis of the final product revealed a nutritional composition comprising 49.09% carbohydrate, 18.89% fiber, 17.19% protein, 5.85% ash, 4.27% fat, and 4.71% moisture. Additionally, the product exhibited a Glycemic Index value of 40.011, indicating a low impact on blood sugar levels. Microbiological testing conducted over two months confirmed the safety of the finalized products, as they did not exceed the acceptable levels for yeast, mold, and total plate count. In conclusion, the study successfully developed an organoleptically acceptable, low Glycemic Index instant herbal porridge using defatted coconut flour.

Keywords: *Defatted coconut flour, Herbal porridge, Oven drying, Proximate analysis, Spray drying*

Characterization of Physico-functional, Antioxidative Properties and Proximate Composition of Selected Yam Flours in Southern Province, Sri Lanka

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ABSTRACT

Yams are popularly grown in the tropical and sub-tropical countries. Mainly yams are consumed in boiled, cooked, roasted or fried form. However, there is a huge potential of using the yam flour for production of composite flour and using for value addition in bakery and other food industries. Therefore, the objective of this study was to analyze the physico-functional, proximate and antioxidant properties of some selected locally available yam varieties namely Arrowroot, *Kiri ala*, *Buthsarana*, *Kahata ala*, *Dandila* (White) and *Dandila* (Purple) and compare those properties with the commercially available wheat flour and white rice flour. The physico-functional properties were analyzed by using standard methods. Proximate composition of flour types was analyzed using standard AOAC methods. DPPH radical scavenging activity, total phenolic and total flavonoid contents were measured using standard methods. In the present study, the bulk density of yam flours ranged from 0.37±0.019 to 0.50±0.03 g/ mL while wheat flour and rice flour showed 0.40±0. 025 and 0.41±0.01 g/ mL bulk densities, respectively. *Dandila* (purple), *Dandila* (white) and *Kiri ala* had similar tapped densities (0.70±0.12 g/ mL) and they were not significantly different ($p>0.05$) from the tapped density of wheat flour (0.77±0.10 g/ mL). All the tested flour types including wheat and white rice flour showed very poor flow characters based on the values of compressibility index and hausner ratio. The highest WAC was showed by *Buthsarana* flour (357±1.45%) and the lowest by *Kiri ala* (164±0.85%) and both were significantly different ($p<0.05$) from the WAC of wheat flour (140%). Highest gelatinization temperature was showed by *Dandila* (white) (78°C) and *Buthsarana* flour showed the lowest gelatinization temperature (65°C) while wheat and white rice flour showed 67°C and 77°C gelatinization temperatures, respectively. Wheat flour showed the highest moisture content (16.11±0.14%) while *Kodol* flour showed the lowest moisture content (6.89±0.05%) among tested flour types. Highest protein content showed by wheat flour (15.21±0.09%) and *Buthsarana* flour showed the highest protein content among yam flours (6.57±1.10%). The highest flavonoid content (14.31±0.10 mg QE/ 100 g) and DPPH radical scavenging activity (138.97±1.01 mg TE/ g) were showed by *Dandila* (white). It can be concluded that yam flour showed comparable and healthier properties compared to the wheat and white rice flour.

Keywords: *Antioxidant properties, Dioscorea spp, Physico-functional properties, Proximate composition, Wheat flour*

Enhancing the Nutritional Quality of Maize Silage Through Incorporation of Pueraria and Gliricidia Forages

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ABSTRACT

Maize (*Zea mays*) silage serves as one of the key energy supplements in ruminant rations, but it has limited crude protein content. This study aimed to improve the overall quality of maize silage by incorporating forage legumes (*Pueraria phaseoloides* and *Gliricidia sepium*). Freshly harvested hybrid fodder maize (*Zea mays* cv. Veera) at the milk to early dough stage, Pueraria with 60 days regrowth, and edible twigs of Gliricidia were chopped using a commercial forage shredder. The experiment followed a completely randomized design with three forage silage treatments: Maize (100%), Maize (60%) with Pueraria (40%), and Maize (71%) with Gliricidia (29%). Forage mixtures of the treatments were compacted into 25 kg silage bales separately and ensiled. After 45 days, the bales were opened, and samples were analyzed for dry matter (DM), crude protein (CP), lactic acid, soluble carbohydrates, ammonia nitrogen, and *in-vitro* metabolizable energy (ME) contents, *in-vitro* organic matter digestibility (OMD) and pH value. Inclusion of Pueraria or Gliricidia in maize silage did not significantly ($P>0.05$) affect the DM and OM content as well as the pH value of silage. Leguminous Pueraria and Gliricidia included silage had significantly higher ($P<0.05$) CP content (11.27% and 11.77%, respectively) compared to maize silage (7.39%). While the silages did not differ significantly in pH value (3.61-3.77, $P>0.05$), the silages containing Pueraria and Gliricidia had significantly higher lactic acid content (14.36% and 12.93%, respectively) compared to maize silage (9.68%, $P<0.05$). The higher protein and water-soluble carbohydrate (WSC) content in legumes may have promoted more robust fermentation by lactic acid bacteria, leading to increased lactic acid production, while their greater buffering capacity may have stabilized the pH value during ensiling. Maize silage and Gliricidia included silage had significantly ($P<0.05$) lower ammonia nitrogen content than Pueraria included silage (0.04% vs. 0.07%). Contrary, maize silage and Gliricidia included silage showed significantly ($P < 0.05$) higher levels of WSC (2.15% and 2.16%, respectively), OMD (57.19% and 54.55%, respectively) and ME (8.50 MJ/ kg DM and 8.05 MJ/ kg DM, respectively) compared to Pueraria included silage (1.29%, 46.93%, and 6.90 MJ/ kg DM, respectively). The study concluded that the inclusion of 29% edible twigs of Gliricidia enhances the quality of maize silage.

Keywords: *Crude protein, Lactic acid, Organic matter digestibility, Metabolizable energy, pH value*

Morphometric Characterization for Economically Important Populations of *Penaeus monodon* Natural Broodstocks in Sri Lanka

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ABSTRACT

Presence of morphological heterogeneity in naturally available broodstocks is a promising characteristic in yield improvement programs, as it provides room for selecting economically important traits for breeding. Morphological characterization of broodstocks for commercially significant traits will therefore be the key to such improvements, and identifying sub-populations with superior economic characteristics will provide leverage in doing so. The present study was an attempt to characterise giant tiger shrimp, *Penaeus monodon* broodstocks from Sri Lankan waters to identify whether or not commercially important sub-populations exist based on morphological characteristics. Ten selected morphometric traits and the body weight were measured from randomly collected 495 samples, representing 55 samples each from nine areas around the country. The economic significance of the selected morphological traits was highly correlated with the body weight indicating the highest correlation from the hepatic spine width (0.967) and the lowest correlation with the width at the midpoint of the abdominal segment six (0.881). Values of morphometric measurements were standardized with equation $LTs_{(i)}=\log_{10}LT_{(i)}[\log 10\ TL_{(m)}/\log 10\ TL_{(i)}]^{b}$. Principal Component Analysis (PCA) in the correlation matrix, both PC1 and PC2 accounted for 68.1% of the total variation representing 48.8% from the PC1 and 19.3% from PC2. In the scatter plot of PC1 and PC2, although all the samples in nine areas as a whole show the nature of belonging to one population, area-wise statistically significant ($p<0.05$) differences in body weight, standard body length, and abdominal length were observed. Rather than the areas that indicate significant differences in the standard body length and abdominal length, the highest significant body weight was recorded in the Mullaitivu, Beruwala, Negombo and Chilaw areas. As it is economically crucial to select parental stocks from areas with higher body weight to improve the profitability of the shrimp farming industry, giving priority to these areas may beneficial. However, it may be helpful to investigate the genetic variation and environmental impact on the population for further improvements.

Keywords: *Morphological heterogeneity, Morphological traits, Penaeus monodon, Population stocks, Shrimp aquaculture*

Effect of a Supportive Structure to Access the Nest Box on Floor Laying Behaviour and Production Performances of Broiler Breeder Chickens

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ABSTRACT

Floor eggs are more often dirty, contain more bacteria on the eggshell and are often broken, or contain more cracks than clean nest eggs. Cracks are an ideal entrance route for penetrating bacteria and have been shown to result in lower hatchability. Floor laying has been reported higher in old aged breeder birds. This study was conducted to assess the effect of a supportive structure (Two tire structure) on the floor-laying behaviour, and production of broiler breeder chickens. Sixty-five weeks aged broiler breeder chickens were allocated to a complete randomized design with male to female ratio of 1:10 and hen-to-nest box ratio of 4:1 including two replicates per the treatment (with the supportive structure) and the control group (without supportive structure). Data were collected for a 6 week period (from week 67 to 72). Behaviour was assessed by scan sampling method by using live observations. Generalized linear model and t- test were used to analyze the treatment effect (SAS 9.0/IBM SPSS Statistics 25). Mating behaviour was not different ($P > 0.05$) in the two groups in all six weeks. In all six weeks, frequency of foraging, resting, standing, walking and preening behaviours were significantly higher ($P < 0.05$) in the bottom tire of the supportive structure. There was no difference in frequency of using of lower tire and upper tire of the structure to enter the nest box. Fertility and hatchability were not significantly different ($P > 0.05$) in between the treatment and control groups for four weeks (from week 67 to 70). In conclusion, the implementation of the supportive structures failed to demonstrate any significant impact on floor egg laying, nest laying, or mating behaviours in broiler breeder chickens which were 67 to 72 weeks age. The added supportive structure had no effect on the fertility or hatchability of hens. Both levels of tires of the supportive structure were utilized in the same frequency to access the nest boxes, whereas the other behaviours were more frequent on the bottom tire.

Keywords: *Behaviour, Broiler breeders, Fertility, Hatchability, Supportive structure*

Effect of Elevated Floor Enrichment on Welfare of Broiler Chickens Reared in Two Litter Materials

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ABSTRACT

Broiler industry is a key sector of the world's poultry production which specializes in the productive and extensive raising of chickens for meat production. The prevailing pattern in the broiler chicken sector in Sri Lanka is moving towards greater intensification with the adoption of closed-house systems. The present study was conducted to assess the effect of litter materials (paddy husk and sawdust) and elevated floor enrichment on welfare (foot pad dermatitis (FPD), hock burns, plumage cleanliness and behaviour) and body weight of broiler chickens living in the cooling pad area. On 14th day of age, 320 Indian River® commercial broiler chicks were randomly allocated to a completely randomized design in four treatments (paddy husk with the elevated floor, paddy husk with no elevated floor, sawdust with the elevated floor, sawdust with no elevated floor) with four replicates (n = 20) per each treatment. Behavior was assessed using the scan sampling method through live observations. Other welfare parameters were individually assessed in each bird during the third week (35 days old) of the experimental period using a scoring system. The generalized linear mixed model and Kruskal-Wallis test were used to analyse the treatment effect (SAS 9.4/IBM and SPSS Statistics). Provided elevated floor significantly ($P = 0.001$) reduced FPD in both litters. There was no significant effect of litter material on the prevalence of FPD. Litter material was affected ($P < 0.05$) on prevalence of hock burns ($P < 0.05$) when elevated floor was provided. However, there was no effect of elevated floor on hock burns. There was a trend ($P = 0.07$) of higher plumage cleanliness and abdominal cleanliness in elevated floor groups. From the 2nd week onwards, litter quality was better in the elevated floor groups ($P < 0.05$) in both litter materials. Higher frequency of preening and resting behaviours were observed in sawdust-elevated floor. Final body weight was significantly higher ($P = 0.001$) in the elevated floor groups. In conclusion, provision of elevated floor enhanced the welfare of broiler chickens while enhancing the body weight.

Keywords: *Behaviour, Broiler chickens, Elevated floor, Litter material, Welfare*

Forage Regrowth and Nutritive Value of Red Napier, Pakchong-1, and Koronivia Grass

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ABSTRACT

Regrowth, and quality of perennial forages vary significantly among cultivars. The objective of this study was to assess the variation in forage regrowth, quality and yield of Red Napier (*Pennisetum purpureum* cross), Pakchong-1 (*Pennisetum purpureum x Pennisetum glaucum*), and Koronivia grass (*Brachiaria humidicola*) harvested at the 6th and 8th weeks of regrowth. The field experiment was conducted at Ridiyagama Dairy Cattle Farm in the low country dry zone during the Maha season. For each forage cultivar, well grown three replicate plots were assigned. An equalization forage cut was followed by weeding and the application of urea fertilizer at rates of 150 and 100 kg/ ha for Napier and Brachiaria cultivars, respectively. Forage growth was measured weekly during the eight-week regrowth period. Half of each plot was harvested at the 6th week of regrowth and the other half at the 8th week of regrowth as split-plot design. Proximate composition, *in-vitro* organic matter digestibility (OMD), *in-vitro* metabolizable energy (ME), and digestible organic matter (DOM) were determined. Red Napier exhibited rapid shoot emergence, resulting in greater ($P<0.05$) shoot density compared to Pakchong-1. Leaf density and basal node circumference of Napier cultivars increased ($P<0.05$) during the eight-week regrowth period. All species harvested at the 6th week of regrowth had higher ($P<0.05$) levels of crude protein (CP), ash, OMD, and ME, while forage harvested at the 8th week of regrowth had higher ($P<0.05$) dry matter (DM), organic matter (OM), neutral detergent fiber (NDF), and acid detergent fiber (ADF) contents. Red Napier harvested at the 6th week of regrowth recorded the highest ($P<0.05$) CP content along with comparable OMD (61.00%) and ME contents (8.88 MJ/ kg DM). Forages harvested at the 8th week of regrowth had higher ($P<0.05$) fresh matter, DM, DOM, and ME yields compared to those harvested at the 6th week of regrowth. At the 8th week of regrowth, the DM and OM yields of Red Napier (9.45 and 7.97 MT/ ha, respectively) and Pakchong-1 (9.20 and 7.69 MT/ ha, respectively) were higher ($P<0.05$) than those of Koronivia grass (3.65 and 3.08 MT/ ha, respectively). Nevertheless, Red Napier harvested at the 8th week of regrowth recorded the highest ($P<0.05$) DOM and ME yields (4.34 MT/ ha and 75.12 GJ/ ha) compared to Pakchong-1 (3.97 MT/ ha and 69.41 GJ/ ha) and Koroniyiya grass (1.55 MT/ ha and 27.09 GJ/ ha). The study concludes that Red Napier, which is particularly notable for its rapid shoot emergence, dense foliage, and CP content, is superior. The forage harvested at 6 weeks of regrowth can be suggested for formulating rations with high CP and digestibility for high-producing cattle, whereas the forage harvested at 8 weeks of regrowth can be suggested for formulating rations for medium-producing cattle.

Keywords: *Composition, Metabolizable energy, Organic matter digestibility, Yield*

Application of ISSR PCR to Determine Genetic Polymorphism Among Cattle of Three β Casein Genotypes in Sri Lanka

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ABSTRACT

The presence of two allelic forms, A1 and A2, in dairy cattles' beta-casein gene can lead to different health implications. While A1 type may contribute to various ailments such as type 1 diabetes and digestive disorders, the A2 type evidently offers beneficial health effects. This necessitates a thorough understanding of genetic components associated with beta-casein genotypes for selective breeding purposes. The present study aimed to detect the DNA polymorphism among cattle genotyped for A1 and A2 alleles. Blood DNA was extracted using a QIAamp mini kit per manufacturer's protocol, from 15 cattle, seven of A1A1, three of A2A2, and five of A1A2 genotypes. The DNA was amplified by microsatellite marker of Inter Simple Sequence Repeat Primers (ISSR) P1 and P2 with sequences of 5'-AGA GAG AGA GAG AGA GAG C-3' and 5'-GAG AGA GAG AGA GAG AGA C-3' respectively, as per published protocols. Amplified products were electrophoresed using 1.5% agarose gel and images were analyzed by GelAnalyzer 23.1. ISSR P1 and P2 primers generated 11 and 09 bands, ranging from 1987bp to 295bp, and 1691bp to 231bp sizes respectively. With ISSR P1 primer, one band of 1342 bp was common in 87.5% of tested 15 animals. One band with a size of 538bp was unique for A1A1 cattle. It was not present in A1A2 or A2A2 groups. Two other bands were present in all A2A2 cattle and one A1A2 cattle, at 1946bp and 659bp. A1A1 group lacked those bands. Another band of 743bp was found to be common among 80% of A1A2 samples. A1A1 or A2A2 groups did not yield that fragment. In ISSR P2, 551bp band was present in all 15 animals and the 255bp band was 78.57% common in all three groups. All A2A2 cattle produced common three bands at 1139bp, 629bp, and 279bp sizes. One A1A2 cattle had a monomorphic band at 368bp. ISSR PCR revealed genetic variations among the tested groups. Animal phenotypic characteristics such as growth rate, milk production, heat tolerance, and fertility may be linked to genetic elements. Sequencing of specific bands would disclose genes related to phenotypic characteristics. 'A2 milk' is gaining popularity and native animals are mostly recognized as sources of A2 allele. Therefore, in dairy upgrading, breeding strategies should be designed to protect genetic balance for sustainability. Present results indicate the effectiveness of microsatellite markers in generating cattle genomic data. Additional analysis with larger groups is recommended for wider application.

Keywords: *β casein, Cattle, Microsatellite PCR, Polymorphism, Sri Lanka*

Development of Nutritious Calliandra Leaf Meal Pellets for Ruminant Rations

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ABSTRACT

Protein supplements used for ruminant feeding in Sri Lanka are expensive. Calliandra (*Calliandra calothyrsus*), naturally grows in the up country wet zone. As a tree legume, Calliandra leaves are rich in Crude Proteins (CP). However, the presence of anti-nutritive factors reduces the nutritive value of the forage. The shedding of leaves during drying limits the production of Calliandra hay, while the high CP content limits its use for silage making. Therefore, this study aimed to produce Calliandra Leaf Meal Pellets (LMP) to be used as a nutritious protein supplement in ruminant rations. Freshly harvested Calliandra leaves were dried and finely ground. The Leaf Powder (LP) was analyzed for proximate composition, *in-vitro* Organic Matter Digestibility (OMD), *in-vitro* Metabolizable Energy (ME) and the biological effects of tannins. The potential to produce LMP with a higher amount of LP was examined by using binding agents such as ground corn, copra meal, rice bran, rice polish, wheat flour and molasses. The inclusion of molasses and wheat flour allowed for the production of LMP with a higher percentage of LP. The highest level of LP that could be incorporated into LMP was determined by experimenting with 5 mixtures containing different percentages of LP (67% - 79%), molasses (11% - 23%) and wheat flour (10%). The mixtures were pelletized, and the dried pellets were analyzed for composition, hardness, OMD and ME. The experiment was conducted as a completely randomized design. The CP, OMD and ME contents of Calliandra leaf powder were 27.05%, 29.17% and 4.08 MJ/ kg, respectively. Significant enhancements ($P<0.05$) were recorded in OMD (29.17% vs. 38.94%) and ME (4.08 MJ/kg vs. 5.57 MJ/ kg) in the presence of Polyethylene glycol (600 mg) in the *in-vitro* gas fermentation assay, confirming the significant ($P<0.05$) biological effect of tannins in Calliandra leaves. The mixture incorporating 79% LP could not be pelletized. The highest level of LP that could be incorporated into LMP was found to be 76%. Furthermore, LMP containing 76% LP, along with 14% molasses and 10% wheat flour, exhibited significantly ($P<0.05$) better nutritive value (21.71% CP, 62.30% OMD, 9.18 MJ/ kg ME) compared to those containing 67% to 73 % LP. The study concludes that Calliandra LMP produced with 76% LP could be used as a nutritious protein supplement in ruminant rations.

Keywords: *Biological effect of tannins Crude protein, Metabolizable energy, Organic matter digestibility*

Comparative Analysis of Sun-Dried and Oven-Dried Fish Meal: A Study of Physical and Chemical Characteristics

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ABSTRACT

In the field of animal nutrition, selecting the right feed ingredients is crucial for maintaining the overall well-being and productivity of livestock animals. Due to rising production costs of feed ingredients, particularly animal protein sources like Fish Meal (FM), the livestock feed prices have skyrocketed. Limited domestic production of FM in Sri Lanka, has led the majority to be imported from overseas resulting high feed cost. Therefore, promoting domestic production would serve as one of the options to reduce continually rising local feed prices and to sustain animal productivity. However, FM produced domestically more often lacks the required quality criteria. Therefore, the present study was carried out to evaluate the physicochemical properties of local FM produced either by (i) sun-dried and (ii) oven-dried methods as a potential ingredient for animal feed. Skipjack tuna (*Katsuwonus pelamis*) obtained from a local fish market was processed to produce sun-dried (32°C; 2-d) and oven-dried (110°C; 45 min) FM. Physical properties such as visual colour, odor and texture, colorimetry, particle size distribution and water holding capacity (WHC) were tested. Proximate composition, gross energy and calcium (Ca) contents of both FM were evaluated in triplicates. The data were analysed using one-way ANOVA. Sundried FM was found to have yellowish brown colour, fresh fishy odor and was fine, sandy and powdery in nature. In contrast, oven-dried FM exhibited medium to dark brown colour, rancid odor and was moist, coarse to fibrous in nature. Sun-dried FM had the highest WHC (139.1±7.45) ($P<0.05$). L* and a* between two FM samples were similar ($P>0.05$). Yellowness (b*) was the highest (12.9±1.00) in sun-dried FM ($P<0.05$). The oven-dried FM had more coarse particles (>2 mm). Significant differences were observed in the moisture, crude protein (CP), ether extract (EE) and gross energy (GE) contents between two types of FM. Sun-dried FM (12.6±0.64%) resulted low moisture content than the oven-dried FM (31.6±0.78%) ($P<0.05$). The highest CP content was found in the sun-dried FM (53.0±0.10%) where the oven-dried FM (39.9±0.27%) reported the lowest ($P<0.05$). Sun-dried FM contained the highest EE (11.7±0.32%) and GE content (4384±7.55 kCal/ kg). The Ca content were not different between samples ($P>0.05$). The present study concluded that based on the physicochemical properties tested, sun-dried FM demonstrate better physicochemical properties than oven-dried FM.

Keywords: *Crude protein, Fish meal, Oven-dried, Physicochemical, Sun-dried*

Management Characteristics and Reproductive Performances of Dairy Farms and Perception of Dairy Farmers on Existing Artificial Insemination (AI) Service: A case study on some selected farms in Matale District

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ABSTRACT

A survey was conducted from February to April in 2023 to study the management characteristics and reproductive performances of dairy farms and perception of farmers on present Artificial Insemination (AI) service provided by the government in Matale district. Data were collected by interviewing dairy farmers from 55 farms, covering all 11 government veterinary ranges in the district using a pre-tested questionnaire and obtaining secondary data available in veterinary offices. Common breeds reared were Friesian, Jersey, Australian Milking Zebu (AMZ) and upgraded local breeds. Only 58% (32/55) of farms were medium scale (10-25 animals) and others were small scale (<10 animals). Intensive management system was practiced by 62% (34/55) of the farmers while others practiced semi-intensive system. Average number of milking cows per farm was 7 (3- 10). It was found that 35% (19/55) of the farms maintained male animals as well for breeding. Study revealed that 95% (52/55) of the farmers were well aware about the advantages of using AI for breeding and 55% (30/55) of the farmers use AI at least twice a month. Average number of AI s required per conception was 2.8 (1- 4). Average daily milk production per cow was 7.5 liters (3- 13). The actual performance of artificial insemination (AI) reached 86% (8893/10345) of the target set by Department of Animal Production and Health. For pregnancy diagnosis (PD), the actual performance was 56.2% (2905/5173) of the target. In terms of calving, 73.4% (2532/3449) of the target was achieved. Notably, only the Dambulla and Laggala veterinary divisions successfully achieved all the targeted numbers for AI, PD and calving. Out of the total 8893 of AI conducted in the district, government AI technicians carried out 4335 (49%). Out of the AIs performed, 44.9% (3993/8893) had to be repeated for the second time and 27% (2401/8893) for the third time. Among the farmers interviewed, 47.3% (26/55) expressed dissatisfaction with the AI services provided by the government veterinary office due to unavailability of AI technicians at the proper time, communication difficulties and the higher prices charged per AI. The other major problems faced by livestock farmers in the district were the lack of quality feeds and extension services. According to veterinary surgeons and technicians the main factors contributing to the failure in AI performance include problems with animal nutrition, improper management, heat detection problems, health and hygiene issues, heat stress, as well as a shortage of adequate AI technicians and veterinary coverage. By addressing these issues, it is possible to improve the reproductive performances and perception of farmers on AI.

Keywords: *Artificial insemination, Dairy, Management, Matale*

Isolation of *Escherichia coli*, *Salmonella* Spp., and *Staphylococcus* spp. from Broiler Chicken Meat and their Sensitivity to Antibiotics

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ABSTRACT

Broiler chicken meat constitutes a pivotal component of Sri Lankan diet. Despite its richness in essential nutrients, contamination of meat introduces substantial risk to public health, also cause food spoilage. Furthermore, the emergence of antibiotic resistance among bacteria represents a severe global threat to both human and animal health, affecting on food security and global economy as well. This can be attributed to the pervasive utilization of antibiotics across diverse sectors, including livestock. The objectives of the current study encompass the isolation of *Escherichia coli*, *Salmonella* spp., and *Staphylococcus* spp., from the broiler chicken meat, along with investigating their susceptibility to selected antibiotics. Hundred and eighty nine swab samples were taken from the neck area of the broiler chicken carcasses during one month period. Isolation of organisms was done by following standard microbiological isolation protocol. Sensitivity of the bacterial isolates (20 *E.coli*, and 30 *Staphylococcus*) to different antibiotics, ampicillin (10 µg), tetracycline (30 µg), cefuroxime (30µg), gentamicin (10 µg), doxycycline (30 µg), ciprofloxacin (5 µg), trimethoprim-sulfamethoxazole (25 µg), chloramphenicol (30 µg), and levofloxacin (5 µg) was detected by using Kirby Bauer disc diffusion method. This study revealed the presence of *E. coli* (27/189), *Staphylococcus* (62/189) and absence of *Salmonella* species in tested chicken samples. All *E. coli* except one, and all *Staphylococcus* isolates were sensitive to cefuroxime and gentamicin. Resistance to ampicillin was observed in 7/20 *E. coli* and 6/30 *Staphylococcus* isolates, contrasting with 12/20 *E. coli* and 24/30 *Staphylococcus* showing sensitivity. Chloramphenicol was a sensitive antibiotic to all 30 *Staphylococcus* and 15/20 *E. coli* isolates, and 5/20 resistant *E. coli* isolates were there. Trimethoprim-sulfamethoxazole demonstrated varied responses, with 13/20 *E. coli* and 26/30 *Staphylococcus* sensitive while 6/20 *E. coli* and 4/30 *Staphylococcus* were resistant. Doxycycline revealed diverse patterns, while 13/20 *E. coli* and 17/30 *Staphylococcus* isolates were resistance to tetracycline. Levofloxacin was an effective drug against most of the isolates, only few isolates were having the resistance. Three out of 20 *E. coli* and 2/30 *Staphylococcus* isolates exhibited resistance to ciprofloxacin in 3/20 while most of other isolates showed sensitivity. This study concluded that *E. coli*, *Staphylococcus* spp., and no *Salmonella* isolates were present in the collected samples, and furthermore, those isolates exhibit varying sensitivities to commonly used antibiotics. Notably, some microorganisms displayed resistance to more than two drugs, indicating potential development of multidrug resistance.

Keywords: *Antibiotic resistance, E. coli, Isolation, Salmonella, Staphylococcus*

Strengths, Weaknesses, Opportunities, and Threats in Goat Farming in Kalutara District

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ABSTRACT

Sri Lankan goat farming, with a population of 363,430 in 2023, plays a significant role in the country's agricultural sector due to goats' efficient conversion of feed into high-quality meat, milk, and hide. Kalutara district, with a reported goat population of 6,400 in 2023, highlights the importance of goat farming as a vital agricultural activity in the area. This practice contributes to the livelihood of many farmers and supports the local economy by providing essential livestock products. The study objective was to carry out strengths, weaknesses, opportunities, and threats (SWOT) analysis of goat farming in Kalutara district. Required information for the study were collected from a field survey conducted among 15 goat farms located in six veterinary areas in the district using a structured questionnaire survey together with the secondary data available in government veterinary offices in the district. The study identified several strengths of goat farming in the area, including the animals' strong adaptability to local climatic conditions and forage availability. It also highlighted that the goat farming requires relatively low capital investment compared to other livestock species and minimal space, making it feasible for smallholder farmers. Additionally, goats provide multiple products such as meat, milk, and manure, which contribute to diverse income streams for farmers. The study also observed that 93% of goat housing in the area is constructed using poles. A significant portion (72%) of farmers have a good knowledge on goat husbandry practices. Several weaknesses such as limiting to rural areas, restricting mainly (80%) to small scale farms with having 1-20 goats, low milk yields due to inadequate feeding practices affecting goat health and productivity, high veterinary costs (average Rs.13,500/ year), limited availability of high-quality breeding stock restricting genetic improvement and overall productivity and inadequate deworming practices contributing to numerous health issues were revealed by the study. The involvement of the young population was comparatively lower (20%). Only 47% of farmers sell animals for meat, and value addition through milk processing was absent. Growing demand for goat meat and milk in urban areas presents an opportunity for market expansion. Also, the potential to increase milk production through artificial insemination, implement machine milking to increase milk quality and processing of goat milk for value addition to increase profitability were identified as opportunities. Threats such as the current economic crisis that strain farmers financially, impacting their ability to afford essentials like feed and veterinary services, prevalence of infectious diseases that lead to high mortality and economic losses (53% of reported deaths) were also revealed. To maximize the potential of goat farming in Sri Lanka, it is crucial to address current weaknesses and leverage strengths and opportunities. By mitigating threats, this sector can improve rural livelihoods and contribute to the national economy. Key recommendations include providing targeted support to smallholder farmers, enhancing infrastructure, and improving market access to realize sustainable growth.

Keywords: *Goat farming, Kalutara, Smallholder farmers, SWOT analysis*

A Study on Characteristics of Dairy Farmers, Production Levels of Cows and Perception of Dairy Farmers on Artificial Insemination (AI) in Ratnapura District

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ABSTRACT

Understanding the characteristics of dairy farmers, the production levels of their cows, and their perceptions of Artificial Insemination (AI) is crucial for enhancing dairy farming practices and productivity. This study examined these aspects in the Ratnapura district, Sri Lanka, aiming to provide insights into the current status and potential improvements in the dairy sector. The survey study was conducted from February to April in 2023 across 17 veterinary divisions within the district. A sample of 173 farmers was randomly selected and interviewed using a well-structured questionnaire that had been pre-tested. The findings revealed that 39.9% of respondent farmer were within the 45-55 age group, with 88.4% being male and 11.6% female. Furthermore, 38.4% of respondents had 10-15 years of farming experience, and 90.1% were engaged in a semi-intensive herd management system. Among the crossbred dairy cattle, 72.8% were Jersey cows, 17.28% were Friesian cows, and 4.2% were Sahiwal cows. In terms of milk yield, 29.6% cows producing 5-10 liters per day, while 20.7% had cows yielding 10-15 liters per day, and 24.9% had cows yielding less than 5 liters of milk per day. Notably, 99.4% of respondents were aware of artificial insemination techniques, with only 0.6% being unaware. Among the respondents, 97.7% utilized artificial insemination for their cows, while 28.2% used both AI and natural breeding methods. Impressively, 85.8% of respondents reported successful outcomes from their artificial insemination programs. Consequently, 84.6% expressed satisfaction with artificial insemination techniques, while 15.4% were dissatisfied due to lack of well-planned AI service. The other major problems faced by livestock farmers in the district were the lack of quality feeds and lack of cows of good breeds. The study highlights that the dairy sector in Ratnapura district is primarily composed of middle-aged farmers with extensive farming experience. While this demographic shows a readiness to embrace technological approaches such as AI, they encounter various practical challenges too. By implementing targeted interventions and offering tailored support services, these challenges can be overcome, leading to increased productivity and sustainability in the dairy industry.

Key words: *Artificial insemination, Dairy farming, Farmer perceptions, Milk production, Ratnapura*

Strengths, Weaknesses, Opportunities and Threats in Swine Industry in Kegalle District, Sri Lanka

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ABSTRACT

The swine industry in the Kegalle District of Sri Lanka presents significant potential for addressing protein malnutrition and enhancing rural livelihoods. The main focus of the study was to identify the strengths, weaknesses, opportunities and threats of the swine industry in the district so as to establish strategies to improve on its functioning. The study was conducted between January and April 2023, and covered all 11 veterinary divisions in the district and involved visits to 26 out of 33 active swine farms, along with 649 pigs. Interviews using pre-tested questionnaires gathered data on farmer demographics, production metrics, resource availability, cultural factors, and economic aspects. The findings underscored several strengths within the Swine industry in Kegalle District. Farmers exhibited high levels of satisfaction and interest in Swine farming, attributed to its shorter income generation period compared to other livestock sectors. Ability to use swill feeding to reduce the feed costs, efficient feed conversion, and abundant water resources were noted advantages. Furthermore, social acceptance and a consistent pork market provided favorable conditions for farmers. However, the study identified significant weaknesses and hindering industry progress. Weaknesses include limited government support, inadequate training opportunities, unavailability of high-quality commercial feed, unavailability of quality breeding materials and high disease prevalence. Weak consumer awareness, myths surrounding pork consumption, and a lack of organized marketing systems were also highlighted. Opportunities for the industry growth were recognized as increasing consumer preference for pork, rising meat demand due to economic growth, and emerging meat processing sectors. Engaging younger generations, particularly through educational initiatives, and involving underutilized demographics like housewives could further bolster the industry. The major threats to the industry included environmental pollution and waste management issues associated with intensive swine farming practices, extreme weather conditions affecting pig health, economic fluctuations impacting veterinary costs, and overall operational expenses and compliance with stringent regulations on animal welfare and environmental standards. While the swine industry in the Kegalle District holds immense potential for growth and development, it is crucial to address existing weaknesses and navigate potential threats effectively. Leveraging strengths such as natural resources and experienced farmers, alongside proactive measures like policy initiatives and education, is essential for long-term sustainability and community benefits. Appropriate application of the SWOT analysis will lead the district to a more sustainable swine industry to ensuring their economic status and food security.

Keywords: *Kegalle, Sri Lanka, Sustainable, Swine industry, SWOT analysis*

An Investigation into Disease Prevalence Among Dairy Cattle in the Matara District of Sri Lanka

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ABSTRACT

Disease outbreaks in livestock directly affect the country's economy since it determines the productivity and profitability of livestock farming. For this reason, it is timely worth to study about the prevalence of common diseases among the different livestock species of the country. Matara district is located in the wet zone where the cattle population is estimated as 8840. A survey was conducted to investigate the prevalence of diseases among the dairy cattle in Matara district using the secondary data available in the government veterinary offices belonging to 13 veterinary divisions of the district (Pitabeddara, Deniyaya, Kekanadura, Malimbada, Dikwella, Akuressa, Matara, Welipitiya, Kamburupitiya, Hakmana, Mulatiyana, Pasgoda and Weligama) for the period from January to December in 2022. Data collected included common diseases in the dairy cattle, frequency of disease outbreaks, common predisposing factors, control measures adopted and the effect of control measures to overcome the issues. All the data were analyzed using Excel. Initial findings identified a range of diseases impacting dairy cattle population in the region. The study found high-risk areas and 56 diseases to be concerned in the Matara district by statistically analyzing 3343 reported cases. Gastrointestinal helminthiasis has been identified as the most prevalent (48.7%) disease in the dairy cattle. It was followed by theileriosis (9 %), clinical mastitis (5.9%) (Sub-clinical mastitis cases are not included for the analysis) and enteritis (5.4%). Other notable diseases included wounds, ephemeral fever, paramhistomiasis, bovine babesiosis, mange, contagious pustular dermatitis and lumpy skin disease. The study also revealed that the prevalence of hemorrhagic septicemia, vaginitis, vertebral damage, bovine salmonellosis, and trypanasoma were less than 0.03% of the total reported cases in the Matara district. The results of the study permit policymakers and stakeholders to make more informed decisions to improve disease control practices for ensuring farm animal health and productivity. The major causes for disease outbreaks in the dairy cattle in Matara district were related to poor management practices. The present situation could be improved to a satisfactory level by increasing the farmer awareness about the impact of proper management and health practices on disease incidences. Therefore, conduction of extensive awareness programmes for livestock farmers on optimal management, farm hygiene and disease control measures including biosecurity is highly recommended.

Keywords: *Dairy cattle, Disease, Management, Matara, Prevalence*

A Study on Storage Temperature in Display Cabinets of Meat Outlets in Colombo District

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ABSTRACT

Ensuring proper storage temperature in display cabinets within meat outlets is essential for guaranteeing the safety, quality, and integrity of meat products offered to consumers. This aspect of food management not only protects public health but also upholds the reputation of the establishment, particularly in areas like the Colombo district, where culinary diversity and food safety are prioritized. The study was done as simple random sampling in Colombo district including all divisional secretariats of the district, primarily focused on investigating storage temperature in 100 display cabinets, and randomly selected meat outlets. Out of them, 92 % of outlets sell broiler chicken with or without other meat types and 38 % of outlets sell only broiler chicken meat. Furthermore, among the studied outlets, 51% offer pork, 48% offer beef and 47% supply mutton and only 2% of them sells turkey meat. According to the questionnaire and face to face interviews with shopkeepers, data was obtained that, when it comes the sales capacity, 43% of outlets had a daily sales capacity of 80-120 kg of meat on average, but due to the economic crisis it had been reduced generally down to 30-60 kg/day or below. The study revealed disparities in temperature management practices among outlets, with 58 % of supermarkets store packed meat products at temperatures between (-16) ℃ to (-20) ^{0}C range, while 4.1 % and 36.5 % of outlets stored packed meat products at the temperature between 0 ℃ - (+4) ℃ and elevated temperatures than +4℃, respectively. Despite efforts to maintain correct storage temperatures, some outlets faced challenges such as exposure to direct sunlight, raising concerns about maintaining optimum temperature. Also, frozen meat storage cabinets were observed in 69 outlets, primarily in supermarkets and large retailers out of the 100 visited outlets. While 58 % of these sixty-nine outlets stored frozen meat products within the recommended range of (-16) °C to (-20) °C, 33.3 % of smaller retail shops stored frozen products at elevated temperatures exceeding (-18) °C. It was revealed that 8% of the outlets store the meat in the room temperature as the supply is done only for predetermined daily demand. Moreover, this study identified the problems and mismatching with the recommended temperature ranges of meat display and storage cabinets. Regular monitoring of display cabinet temperatures is emphasized as essential to ensure they remain within safe ranges. This includes using reliable temperature monitoring equipment, setting alarms for deviations, and training staff to address issues promptly.

Keywords: *Chicken, Display cabinet, Meat, Storage, Temperature*

A Study on Management and Production Profile of Dairy Farming in Five Selected Veterinary Divisions in Nuwara Eliya District, Sri Lanka

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ABSTRACT

Nuwara Eliya district is well known for its production aspects in the dairy sector. A study was conducted to examine the current management and production status of dairy farming in some selected veterinary ranges in the Nuwara Eliya district. The study was conducted in 05 veterinary divisions out of 12 in the district (Nuwra Eliya, Talawakale, Hatton, Pundaluoya and Thispane) by personally interviewing randomly selected 110 dairy farmers using a structured questionnaire. Data were analyzed using Microsoft excel 2016. The majority of farmers (93.6%) engaged in dairy farming in these regions were male and only 6.5% of females were involved. In most families (57.3%), the chief of household was involved in rearing cows while only in 27.3% families the housewife involved in cattle rearing. The involvement of children was only 14.5%. Common cattle breeds reared were exotic breeds (91.8%) and cross bred animals (7.3%). The average herd size was 3.7. Twenty-one farmers reared only one cow, 65 farmers reared 2-5 cows and only 24 farmers reared more than 6 cows. Majority of farmers (66.4%) reared cows under intensive management systems whereas 30.9 % used semi – intensive and only 2.7% farmers followed extensive management systems. Closed barn housing systems were more preferred by the farmers (78.9%) rather than the open house systems (21.1%). Only 7 farmers (6.7%) used the machine milking and the rest were using hand milking method. It was revealed that 99 farmers (90%) do milking twice a day in the morning and evening while only 11 farmers (10%) do milking three times a day. The daily average milk production of exotic breeds was 14 liters whereas in cross breeds it was 9 liters. The milk sold in fresh form by majority of farmers while only 3.7% of the farmers utilized a proportion of milk for processing to produce yogurt, curd and milk toffee etc. Routine vaccination was practiced in 98.1% farms and routine deworming was practiced in 88.9% farms. Major cause of death among cattle were reproductive complications and improper management practices. Most of the farmers fed their cows with sufficient amount of grasses and concentrates (commercial cattle feed and poonac) in the morning, afternoon and in the evening, but 38.1% of farmers didn't feed their cattle in the afternoon. High feed cost, unavailability of quality feed, high drug and veterinary costs were the main problems associated with the dairy sector. The study highlighted the poor involvement of women in dairy industry in the study area. The intensive management practice is widely used for exotic dairy breeds in the area. Though major management and health practices are satisfactory in the dairy sector in the study area, it revealed that there is a huge necessity to motivate dairy farmers of the area for value addition of milk to improve the profit margin.

Key words: *Dairy farming, Herd management, Management practices, Milk production, Nuwara Eliya District*

Agribusiness and Agricultural Economics

Use of AI in Forecasting and Managing the Crop Production and Marketing System in Sri Lanka

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ABSTRACT

Sri Lanka's agricultural sector faces different challenges like resource constraints, climate variability, and market unpredictability, necessitating innovative solutions for sustainable crop production and effective marketing management. The revolutionary potential of Artificial Intelligence (AI) in resolving these issues in Sri Lanka's agricultural sector is examined in this abstract. AI-powered tools for decision-making, such as predictive modeling, data analytics, and machine learning, give stakeholders access to data-driven insights. By evaluating a variety of variables, including past yield data, weather patterns, soil health indicators, and agronomic methods, AI helps farmers use precision agriculture in crop production. This allows farmers to optimize resource allocation, reduce input waste, and manage various risks in crop production. Moreover, by examining consumer behavior, trade dynamics, and market trends, AI-powered predictive modeling improves the accuracy of market forecasts and helps stakeholders plan ahead for changes in demand, adjust prices, and simplify supply chain operations. Despite efforts to incorporate AI into farming methods, obstacles such as lack of adequate data, inadequate infrastructure both physical and human, and socioeconomic inequality prevent the technology from being widely used. To overcome these obstacles, investments in data infrastructure, capacity building, and stakeholder collaboration are needed, in addition to legal frameworks and legislative support that will encourage the adoption of AI while guaranteeing equal access. The incorporation of AI has the potential to revolutionize Sri Lanka's agriculture industry by providing avenues for improving sustainability, resilience, and production. This would eventually guarantee a more prosperous future for farming communities and the country at large. Use of AI will guarantee an optimum crop production by using minimum resources and equilibrium in the supply and demand of agricultural products for both consumers and industries. Hyperspectral imaging and 3D laser scanning can be used as AI based technologies to ensure crop health. AI will help farmers to automate their small to medium scale farms and move towards improved and precise crop production with optimized higher yields in high quality with minimum use of input resources. Further, they can use AI to get real-time insights for their farm's identification of irrigated water, fertilizer, and pesticides applications. AI assists in increasing total farm productivity and market efficiency by supplying timely demand to the market.

Keywords: *AI crop production, Artificial Intelligence, Market forecasting, Precision agriculture.*

Tendency of Sri Lankans to Switch from Ready-Made Spices to Homemade Spices

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ABSTRACT

The shift from ready-made to homemade spices is becoming increasingly prominent, with significant implications for consumer behaviour and the spice industry. This study investigates the growing trend towards homemade spices among Sri Lankan families, analyzing the socio-economic, health, and cultural factors influencing such a shift. The study engaged 178 families across different universities in Sri Lanka, employing a structured questionnaire aiming at spice usage preferences, health perceptions, and socio-economic status. The study took three months to collect the data and the data analysis was done using SPSS version 22 software and Microsoft excel 2016 software. The study revealed a strong preference for homemade spices, with 93.2% of respondents favouring them over ready-made spices. However, there remains a notable disparity in actual usage of homemade spices, with only 64.6% using homemade spices regularly. This indicates a gap between preference and practice, due to the convenience of ready-made products. Health concerns significantly influence the preference for homemade spices. 75.3% of respondents do not consider ready-made spices healthy, primarily due to concerns over additives and preservatives. Furthermore, the quality of the products is prominent, with 88.8% of respondents giving attention to the quality of spices, highlighting the significance of the transparency of the ingredients and quality in spice production. Families with lower incomes are more likely to use homemade spices, likely due to the cost-effectiveness compared to ready-made spices. About 43.8% obtain spice materials locally, and 19.1% cultivate their own, supporting the local economy. There is a clear demand for home-made spices, mainly because of the health issues and the low trust about the ingredients in ready-made spices. Therefore, the industry is presented with opportunities for introducing certified healthy products, improving transparency in ingredient sourcing, and enhancing the overall quality of ready-made spices to align with consumer expectations.

Keywords: *Homemade spices, Ready-made spices, Spice consumption, Sri Lanka*

Identifying Distinct Consumer Segments in Sri Lanka Based on Their Concerns about Purchasing Fresh-cut Vegetables

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ABSTRACT

Fresh-cut vegetables (FCVs) form part of the mix of ready-to-eat or cook food products that serve the growing market segment of wellness-oriented consumers with busy lifestyles. Identifying and profiling this distinct segment of consumers is an important factor for guiding product development, improving customer satisfaction, and optimizing available resources and costs. This study aimed to identify distinct consumer segments within the FCV market based on their purchasing concerns. No research has yet been done on this topic in Sri Lanka. The study was conducted as a cross-sectional survey of Sri Lankan households, especially focusing on urban areas in Sri Lanka. Purchasing concerns related to FCVs were measured using 12 items on a five-point Likert scale. A total of 1722 responses were collected from face-to-face interviews and an online questionnaire was selected through random sampling technique. Initially, factor analysis was employed using the Kaiser criterion to reduce the 12 purchasing concerns into a smaller set of factors. Accordingly, three component factors, namely, quality, safety, and presentation of the product were extracted, which accounted for approximately 62% of the total variance. Based on those factors, FCV consumer segments were derived using k-means clustering followed by hierarchical clustering (Ward's method) based on standardized factor scores. Cluster analysis results indicated that consumers can be grouped into three segments: consumers who are 1) less concerned about all three factors (the smallest cluster); 2) moderately concerned about all three factors and quality-driven consumers; and 3) highly concerned about all three factors and safety-driven consumers. Most consumers in all clusters indicated that: convenience is the main reason to buy FCVs; price is also important; tap water is preferred to be used as the disinfection agent; and eco-friendly materials are preferred for packaging. In terms of demographic factors, most of the consumers in the first 2 clusters had completed advanced-level education, and the majority of 3rd cluster consumers had completed university education. With expected labeling information, quality-driven consumers expect the shelf life of the product and logos of quality assurance as labeling information, while safety-driven consumers expect disinfecting agents, along with their concentration and preservation techniques to be available. These findings can be effectively used in product development and marketing decisions.

Keywords: *Cluster analysis, Consumer segments, Factor analysis, Fresh-cut vegetables*

Value Chain Analysis of Palmyrah (*Borassus flabellifer*) Sap Based Products in Jaffna District, Sri Lanka

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ABSTRACT

The Asian Palmyrah (*Borassus flabellifer*), pivotal to Sri Lanka's northern economy, holds significant industrial potential, similar to the influence of the coconut industry on the country's agricultural and industrial sectors. Despite this, limited studies have explored the unique value-addition opportunities in palmyrah sap-based productions within the Jaffna District. This study aimed to identify and map the key actors in the value chain for fermented products such as toddy, bottled toddy, and palmyrah arrack, as well as the non-fermented product, jaggery. Profitability was analyzed by calculating the value addition and gross profit margin percentages at each level of the value chain. Additionally, a SWOT analysis was conducted to assess the industry's strengths, weaknesses, opportunities, and threats. A total of 62 actors, including tappers, processors, exporters, agents, sellers, the Multi-Trade Centre, the Multi-Purpose Co-operative Society (MPCS), wholesalers, retailers, and key informants, were purposively selected for this study. Data were collected using a pre-tested semi-structured questionnaire. The findings revealed that tappers achieved high gross profit margins of around 95.5%, primarily due to low tapping costs distributed over the entire season. Exporters recorded higher gross profit margins (bottled toddy 42.86%, palmyrah arrack 20.8%, and jaggery 32.84%) compared to processors (bottled toddy 39.75%, palmyrah arrack 4.47%, jaggery 25.94%). Retailers also enjoyed a substantial gross profit margin of 41.41% in the jaggery industry. However, the future of the palmyrah sap-based industry is at risk due to the challenging nature and social status of the tapper profession, which discourages the younger generation from entering the field. To ensure the industry's sustainability, it is crucial to develop a strong brand identity for palmyrah sap products, emphasizing their cultural significance, health benefits, and sustainable production methods. Expanding market access requires exploring new domestic and international markets through enhanced marketing and distribution channels.

Keywords: *Jaffna, Palmyrah sap-based industry, Value addition, Value chain*

Farmers' Intention on Initiating Agro-tourism to Experience *Jhum* or Slash-and-Burn Cultivation at Khagrachari, Bangladesh

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ABSTRACT

The objective of the study is to measure the farmers' intention to initiate agro-tourism providing the experience of traditional and organic *Jhum* cultivation in Khagrachari, Bangladesh so that the traditional process of *Jhum* cultivation can be preserved, authentic agro-tourism can be offered and socio-economic empowerment can be ensured. The study is qualitative in nature. Open ended questionnaire was used to conduct semi-structured focus group discussion. Six items were used to understand farmer's intention. Here non-probability sampling technique was adopted and convenience sampling was followed to select seven respondents (five male and two female) from three ethnic groups (5 Chakma, 1 Marma and 1 Tripuri) for data collection. Discussion session was conducted using local language as the respondents are not fluent in English. Primary data was collected in May, 2024 and secondary data was incorporated from the available sources. Grounded theory was followed and discourse analysis was conducted to conclude the outcome by analyzing and translating the recording of the discussion. The outcome of the study shows that respondents are eager to initiate agro-tourism as they don't want to sway from their traditional profession and cultivation process. They are optimist to earn additional revenue from seasonal or frequent tourist visiting their community as well. The practical implications of the study are, (i) Introduction of agro-tourism in mountain or hill area where traditional cultivation can provide unique experience to tourists, (ii) Focus on ethnic and underprivileged community dependent on agriculture, (iii) Scope of integrated approach with rural and agro-tourism in other region of Bangladesh. The limitation of the study is limited number of respondents. Scopes of future research are, (i) comparative analysis on agro-tourism focusing specific ethnic community in Bangladesh, (ii) determinants of agro-tourism development, (iii) factors affecting sustainable agro-tourism development, etc. In a nutshell, though Rangamati and Bandarban are highly hill areas, Khagrachari was selected for initiating agro-tourism using *Jhum technique* so that deforestation and soil erosion will not cause diversified agro cultivation in Khagrachari.

Keyword: *Agro-tourism, Chittagong Hill tract, Ethnic Community, Jhum cultivation, Socio-economic empowerment*

Unveiling Food Consumption Pattern and Coping Strategies: Insights from Maize, Big Onion, Chilli and Potato Farming Communities in Sri Lanka

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ABSTRACT

In Sri Lanka, maize, big onion and chilli beyond rice, playing a vital role in bolstering national food security. Potatoes, in particular, have gained prominence as a significant cash crop due to high consumer demand and profitability. Farmer households engaged in maize, big onion, chilli and potato cultivation face challenges such as unstable income, job insecurity, climate change impacts, price fluctuations and crop losses, all of which diminish their purchasing power and threaten food and nutrition security. Despite being crucial to food security, there is a notable lack of studies specifically examining the food consumption, coping strategies which leads to food security status of these farming communities, highlighting a significant gap in research. In this context, an attempt was made through the present study to assess the food consumption and coping strategies with food security status of maize, big onion, chilli and potato farmer households in Sri Lanka. Primary data were collected through a questionnaire with 703 farmer households in Anuradhapura, Monaragala, Kurunegala, Puttalam, Hambantota, Badulla, Nuwara Eliya and Matale. Maize, chili and big onion were selected to represent the entire other field crops sector. Potato was chosen for its status as an essential cash crop with high consumer demand. Collected primary data were used to estimate the food consumption score (FCS), reduced coping strategies index and food security level using the Consolidated Approach for Reporting Indicators of Food Security developed by the World Food Programme. Nearly 70 percent of farmer households are categorized as having acceptable food consumption, with FCS values greater than 42. The average number of days consumed of cereals (7 days), vegetables (5 days), fat/oil (6 days) and sugar (6 days) are higher compared to dairy products (2 days), and protein based products (2 days) and fruits (2 days) in the total sample. When considering the consumption of expensive food commodities such as dairy products, meat, eggs and oil-based products, their consumption decreased due to high prices, leading to the consumption of less expensive food commodities. The least proportion of the study sample, 7.8 percent, depends heavily on coping strategies for food. 70 percent are classified as food secure, meaning they have sufficient food access and are not experiencing food insecurity. Despite food inflation and economic constraints, maize, big onion, chilli and potato farmer households have largely upheld their food security.

Keywords: *Big onion, Chilli, Food consumption score, Maize, Potato, Reduced coping strategies index*

Consumer Awareness and Level of Preference for Consuming Organic Milk Products: A Case Study among Millennials in Western Province, Sri Lanka

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ABSTRACT

Organic milk products are derived from livestock raised without synthetic pesticides, fertilizers, antibiotics, or growth hormones, and they offer higher levels of omega-3 fatty acids, antioxidants, and vitamins compared to conventional milk. These products are gaining popularity among newer consumer generations, particularly Millennials (Generation Y) and Generation Z throughout the world, driven by increasing health consciousness and environmental awareness. This global trend reflects a shift towards sustainable and health-oriented consumption patterns. The current study aimed to evaluate the level of awareness and preference for consuming organic milk products among Millennials in Sri Lanka, along with examining potential factors associated with the level of preferences. The Means End Chain Theory was used as a theoretical foundation for the research. This research adopted a quantitative approach utilizing a questionnaire survey design and was conducted in the Western Province of Sri Lanka. A purposive sampling technique was employed to select a sample of 194 Millennials, born between 1981 and 1996. Data collection was facilitated through a self-administered online questionnaire, ensuring ease of access and participation. The level of awareness and level of preference were measured using pre-validated scales. Product attributes, functional consequences, psychosocial consequences, and personal values were considered as potential factors related to the preference level. The collected data were subjected to descriptive statistics to summarize the findings and correlational analysis to identify relationships between variables. The results indicated that only 21% of the sample was initially aware of the concept of organic milk products. However, after being provided with a proper definition, 83% of the sample expressed a preference for consuming these products. The strength of both awareness and preference levels was moderately positive. Additionally, significant and moderately positive correlations were found between the level of preference for consuming organic milk products and all examined factors: product attributes, functional consequences, psychosocial consequences, and personal values ($p < 0.05$). The study concludes that although initial awareness of organic milk products among Millennials in the Western Province of Sri Lanka is low, there is a strong preference for these products once they are informed. Moreover, according to the results, product attributes, functional consequences, psychosocial consequences, and personal values were significantly associated with this preference. These findings imply the need for targeted awareness campaigns to boost knowledge and consumption of organic milk products. Enhanced marketing strategies focusing on the health and environmental benefits of organic milk could further elevate preference and demand among selected demographic cohort.

Keywords: *Consumer awareness, Consumer preference, Millennials, Organic milk products, Sri Lanka*

Determinants of Consumers' Purchase Intention Towards Sugar Free Biscuits: A Study in Matale Town, Sri Lanka

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ABSTRACT

Biscuits are a widely consumed and convenient quick energy snack, where its market is shifting drastically towards healthier options, such as sugar-free varieties. This shift reflects a growing consumer preference for less sugar intake and healthier dietary choices. To empirically investigate this trend in Sri Lanka, understanding consumer attitudes and perceptions on sugar-free biscuit consumption becomes crucial for both producers and consumers. Identifying factors that influence purchase intentions on sugar free biscuits can aid businesses developing more effective marketing strategies while delighting their customers. This study investigated consumer purchase intention towards sugar-free biscuits and its determinants in Matale town, Sri Lanka, using a sample of 238 consumers selected through snowball sampling technique. Data were gathered on intention to consume sugar free biscuits, associated attitudes of healthiness, safety, quality, overall value and perceptions on 4Ps marketing mix elements, through a structured questionnaire survey and analysed using descriptive statistics, Pearson's correlation, and multiple linear regression techniques. Descriptive statistics revealed that consumers hold moderately strong attitudes, perceptions on 4Ps and purchase intention towards sugar-free biscuits. Moreover, the purchase intention showed significant and moderately positive correlation with attitudes on healthiness, safety, quality, overall value and perceptions on marketing mix elements of product, place, and promotion ($p < 0.01$, two tail). In contrast, the price of sugar-free biscuits showed a significant and strong negative correlation with purchase intention ($p < 0.01$, two tail). The regression analysis further confirmed that both consumer attitudes and perceptions of the 4Ps significantly influence on the intention to purchase sugar-free biscuits ($p < 0.05$). These insights suggest that capitalizing more on favourable attitudes and perceptions while addressing negative perceptions related to price is essential for businesses to enhance consumer intention to buy sugar free biscuits. By focusing on these insights and refining pricing strategies appropriately, manufacturers can better align their offerings with market demands and enhance their competitiveness in the sugar-free biscuit market.

Keywords: *Attitudes and perceptions, Biscuit consumers, Purchase intention, Sri Lanka, Sugar-free biscuits*

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