

**RISTCON 2019**

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6<sup>th</sup> Ruhuna International Science and  
Technology Conference**

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## Editorial Note

Thanks to all the contributors, we received high number of abstracts in diverse disciplines for RISTCON-2019. All of them were initially screened by the editorial board for novelty and plagiarism. Then each abstract was sent to two experts in the relevant field, serving in different universities/research institutes, for a double blind review. In cases where the decisions by the two reviewers were remarkably different, the abstract was sent to a third reviewer. Final decision was taken by the Editorial board by considering the decisions as well as comments made by all reviewers. We believe that, this process has ensured a high standard of the publication through a quality and unbiased review.

However, the responsibility for the content and the message of each publication remains with the respective authors. No part of this serial publication will be reproduced by any form. When citing the abstracts published, this serial publication can be referred as 'Proceedings of the 6<sup>th</sup> Ruhuna International Science and Technology conference, Faculty of Science, University of Ruhuna, Matara, Sri Lanka'.

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RISTCON 2019

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## **Message from the Vice Chancellor, University of Ruhuna**

I am pleased to write a message for the 6<sup>th</sup> Ruhuna International Science and Technology conference (RISTCON) -2019, conducted by the Faculty of Science, particularly at this point when the University of Ruhuna completed four decades of its service to the country and to the world.

Honoring the commitment for our primary objective, providing a quality service in teaching undergraduate and postgraduate students, we have been playing a pivotal role in generating the knowledge. As a result, we were able to reach to the top among State universities in Sri Lanka, in terms of ‘knowledge generation’ or ‘research’.

Dissemination of the knowledge generated is of prime importance and a key responsibility, particularly of the sectors that generated the knowledge, as there is no validity for the knowledge generated without dissemination. Conferences are essential and ‘world accepted’ way of validating the generated knowledge. The RISTCON is one of the well-established platform which facilitate the dissemination of new knowledge and receiving feedback from scientists, scholars and academics from a wider range of subject disciplines within the country as well as from abroad.

Moving ahead on the path of excellence we followed during the last four decades, the University of Ruhuna is ready to take up the forthcoming challenges in diversified domains. One of the major challenges the ‘research culture’ has to face is ‘fake or predatory journals’ and ‘fake conferences’. In this age of globalization and information technology, there are many spaces for such pseudo platforms. The RITSCON, which maintain a high standard as a credible conference, is one of the forums that can be maintained by University of Ruhuna as a solution for the problem of ‘Fake conferences’.

I hope that the conference organizers and the participants are able to achieve their goals and objectives adding value to the knowledge the participant have generated.

**Senior Professor Gamini Senanayake**  
**The Vice Chancellor**  
**University of Ruhuna**

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

Providing a message as the Dean of the Faculty of Science of the University of Ruhuna to 6<sup>th</sup> Ruhuna International Science and Technology Conference (RISTCON-2019) is a great pleasure for me. RISTCON has been providing platform for discussing findings of researchers, practitioners and educators from various scientific fields such as biological science, physical science, medical science, environmental science and technological and engineering fields for several years. The series of gatherings organized by the Faculty of Science initially as Science Faculty Symposium from 2002 opened its doors to both local and foreign contributors with RISTCON-2014. It is indeed happy to learn that RISTCON-2019 has received around 106 submissions and many of them will be presented as poster or oral presentations. I would like to thank all the authors who submitted their findings to RISTCON-2019 for their efforts in research work and willingness to share their findings among the contributors and the participants of the conference.

It is evident that our country requires collaborative efforts and contributions of researchers, policy makers, governing bodies and citizens for enhancing and developing the socio-economic status of the country. There are many areas we must consider in order to develop our country so that every person in the society enjoys a high standard of living. For assisting the society to achieve this target, the researchers have an unavoidable responsibility of coming up with suitable ways specific to the country and disseminate that knowledge among the society with the aim of the development of the country. I wish the conferences like RISTCON should be platforms for our researchers to share our scientific knowledge and new findings with the special target towards the development of the country in every aspect.

Organizing a conference is a very difficult and responsible task and therefore I would like to convey the gratitude of the Faculty of Science of the University of Ruhuna to Professor M. P. K. S. K. De Silva, the Chairperson of the Organizing Committee of RISTCON-2019, and her team for their creative, effective and untiring efforts for making this conference a reality.

I hope and wish all the presenters and participants would enjoy the humanity and the hospitality of our community at the Faculty of Science of the University of Ruhuna.

**Professor P. A. Jayantha**  
**Dean and Professor of Mathematics**  
**Faculty of Science, University of Ruhuna**

## **Message from the Chairperson - RISTCON 2019**

On behalf of the Organizing Committee, it is with great pleasure that I welcome all the presenters and participants to the University of Ruhuna in the city of Matara to join us for the 6<sup>th</sup> Ruhuna International Science and Technology Conference (RISTCON) 2019. RISTCON is the result of the dedicated academics at the Faculty of Science of the University of Ruhuna. After nine annual Science Symposia in national level since 2002, the Faculty of Science progressed to an international conference as RISTCON in 2014 thus opening doors for research interactions among peers across multiple science disciplines.

RISTCON 2019 is organized under the theme “Science and Technology research towards knowledge transfer and social development”. During this conference, presentations on various disciplines of science and technology will be showcased on one stage promoting the exchange of latest technical information, the dissemination of high-quality research results, presentation of new developments and the discussion of strategies for future social development.

All RISTCON 2019 publications are peer-reviewed by national and international experts in their respective fields. A six-member editorial board has assessed all abstracts for novelty, plagiarism and language to maintain the highest quality standards of the publications. The untiring efforts and devotion of the editorial board is respectfully appreciated. I am sincerely thankful for the contributions of all authors and reviewers from national and international Universities/Institutes in making RISTCON 2019 a pinnacle event.

I extend my sincere gratitude to the Vice Chancellor of the University of Ruhuna Senior Professor Gamini Senanayake and the Dean of the Faculty of Science Professor P.A. Jayantha, for the encouragement, guidance and support provided in making RISTCON 2019 a reality. I also extend my sincere gratefulness to our honorable keynote speaker Professor Rolph Payet and the honorable invited speaker Professor Chandana Jayaratne for accepting our request and sharing their knowledge with RISTCON 2019 participants amidst their busy schedules. A special thanks goes to our sponsors for their generous contributions.

I hope you find the conference enjoyable and valuable and openly invite you to take time to enjoy the historical, architectural and natural beauty of the University of Ruhuna and the city of Matara.

**Professor M. P. K. S. K. De Silva**  
**Chairperson**  
**Organizing Committee of RISTCON 2019**

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List of reviewers - RISTCON 2018 67

## **Details of the Sessions**

**Session A:** Agriculture, Botany and Molecular Biology & Biotechnology

**Session B:** Chemistry, Biochemistry, Biophysics, Ecology, Environmental Science and Oceanography

**Session C:** Zoology, Fisheries & Aquaculture, Medical & Health Sciences and Veterinary Science

**Session D:** Engineering, Physics, Mathematics & Statistics, Computer Science & ICT and Nano Technology

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*Abstract of the Keynote Speech*

**The Role of Science and Technology in the implementation of the Sustainable Development Goals (SDGs) and Multilateral Environmental Agreements (MEAs): Opportunities and Perspectives for Developing Countries**

Prof. Rolph Antoine Payet

*Executive Secretary of the Basel, Rotterdam and Stockholm Conventions,  
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Human civilizations throughout our history have expanded, contracted and some even eliminated despite great advancements in science, technology, agriculture and trade. The advancements were made possible due to inventions and innovations in almost all the areas.

Many are of the view that the main reasons for failures taken place in human civilization are linked to the sustainability paradigm. Such civilizations failed to appreciate the relationship between human development including economic growth and the environment. Due to this weakness, the long-term sustainability remains disconnected to this day despite the best of efforts. When we consider those failures and taken as lessons to predict the future, one can ask following questions;

- Are we on the edge of another tipping point in human civilization?
- Will our advancements in chemicals and product development, which have enabled us to enter the information age ultimately lead to our demise as the most progressive civilization since the Romans? Do the sustainable development goals provide a way forward?
- Can Science and technology change this dangerous pathway that our civilization is currently locked in?

All these are very pertinent questions grappling both academics and policy-makers across the planet as we move to tackle global issues such as climate change, biodiversity loss, pollution, and right now marine plastics!

This presentation will attempt to answer the last question above and provide some insight into how this can be done, not only from a technological perspective, but also a social economic and policy perspective.

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*Abstract of the Guest Speech*

**Need of knowledge transferring at school level towards sustainability in the face of invading artificial intelligence, machine learning and automation technologies**

Prof. K.P.S. Chandana Jayaratne

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New technologies such as artificial intelligence, machine learning, robotics and automation are reshaping the workplace globally. All countries will feel the impact in some way. There are several benefits of replacing the labor force by robotics under automation such as boosting the economy of a country, giving more productivity to reduce price of commodities. However, with the development of Automation and Artificial Intelligence, it is said that 70 % of the jobs that we are having today will disappear in next two decades and many people with current education system will have no jobs. Among the large number of jobs that are in threat are bank tellers, farmers, drivers, manufacturing workers, journalists, movie stars and even the medical doctors. For example, vehicles will go without drivers and in future, instead of driving, the drivers should change their job to repair those automated cars or instruments. But this needs education reforms in a country on teaching Science stream subjects at school level to create special skills. To take a student out from the high school, it takes about 12 years and if we do not pay attention to this factor now, in the next decade there will be a lot of issues associated with high unemployment rate. The governments should therefore adopt policies soon to avoid or at least mitigate the problems automation will bring. Proper knowledge transfer on science and technology to the younger generation should be made. Youngsters should be prepared to face tomorrow's automated world with confidence. The most sought-after model to achieve this is STEM education.

STEM education is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply Science, Technology, Engineering, and Mathematics in contexts that make connections between school, community, work, and the global enterprise. Several countries around the globe have already adopted STEM education and Sri Lanka too is currently developing its draft policy document on STEM education.

## **Identification of high yielding genotypes of rubber (*Hevea brasiliensis*) at the early stage of their breeding cycle using rubber elongation factor (*Ref*) gene and promoter**

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*Hevea brasiliensis* (Willd. ex A. Juss.) Muell. Arg. is the main species producing natural rubber, which is an important industrial raw material. Rubber Elongation Factor (*Ref*) is a major protein, which involves in rubber biosynthesis. *Ref* protein is highly homologous to the *Ref* gene. This research was conducted to analyse the nucleotide sequences of the *Ref* gene and *Ref* promoter of seven genotypes of year 2011 in a hand pollinated progeny (HP-42, HP-231, HP-202, HP-300- high-yielding, HP-19, HP-124 and HP-297 low-yielding), along with the selected five wild accessions (RO 22/63, MT 11-76-I, MT 11-76-II, MT 11-13 and MT 10-146) of *H. brasiliensis* to develop a molecular marker to early identification of high-yielding genotypes. Already characterized, four *H. brasiliensis* clones (high-yielding and low-yielding Wickham genetic base) were used as controls for the analysis. PCR amplification of genomic DNA of all experimental materials resulted around 1250 bp fragment with *Ref* gene specific primer pair and around 700 bp fragment with both *Ref* promoter-specific primer pairs. No difference in base sequence was observed among high and low yielding clones, genotypes and wild accessions. Therefore, sequencing analysis of the *Ref* gene and *Ref* promoter showed the similar sequence in both low and high yielding clones. Sequence analysis should be carried out further for different regions of other genes of *H. brasiliensis*.

**Keywords:** *Hevea brasiliensis* clone, *Ref* gene, rubber elongation factor

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## **Isolation and identification of phytobeneficial properties of rhizobacteria isolated from banana rhizosphere**

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Identification of phytobeneficial properties of rhizobacteria is an important strategy to screen plant growth promoting rhizobacteria (PGPR) that can be utilized to increase crop yield and thereby fulfill the increasing demand for global food production. In this study rhizobacteria were isolated from the rhizosphere of Silk banana (*Musa acuminata* × *Musa balbisiana*) growing in Matara and Galle area and assessed their potential of phytobeneficial properties. Out of the 32 rhizobacterial isolates, 17 isolates including 4 endorhizosphere bacteria were identified as plant growth promoting rhizobacteria based on their phytobeneficial properties. Among them, 13 isolates possessed indole-3-acetic acid production ability and 9 isolates possessed phosphate solubilizing ability. Among the top 5 isolates with highest potential to produce indole-3-acetic acid, 2 were shown biofilm formation ability. According to the preliminary investigation, 6 isolates showed the ability to fix atmospheric nitrogen. Following established biochemical tests, the characterized plant growth enhancing rhizobacteria were identified as the members of genera *Staphylococcus*, *Streptomyces*, *Bacillus*, *Pseudomonas* and *Azotobacter*. Isolates belong to genera *Staphylococcus* and *Streptomyces* had high potentials in plant growth promoting properties than the other isolates. Inoculation of seeds of selected legume species with these selected plant growth promoting isolates resulted in significant enhancement in seed germination (60% increment) and significant enhancement in root and hypocotyl length (3.74 fold increment) compared to control experiment. It is important to focus our consideration for the development of biofertilizers using these selected rhizobacterial strains as they have shown multiple growth promoting characteristics.

**Keywords:** Rhizobacteria, Rhizosphere, Indole acetic acid, Seed germination, Biofertilizer

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## **Production of transgenic *Petunia* (Solanaceae) with enhanced hypersensitive response to *Pseudomonas syringae***

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Incompatible pathogen responses are frequently associated with cell death in the host plant at the site of infection by pathogens and referred to as hypersensitive response (HR). HR causes pathogen arrest and also leads to activation of defence genes. Phospholipase A (PLA) is an important enzyme group involved in many signal transduction pathways including pathogen defence responses. Potential involvement of *Arabidopsis thaliana* phospholipase. Genes namely, *AtPLA IIA* and *AtPLA IIB* in pathogen responses was tested by transforming *Petunia hybrida* (Family Solanaceae) for overexpression (sense) and suppression (antisense) of these genes. *Agrobacterium* mediated leaf disc transformation method was employed to produce transgenic *Petunia*. Development of HR was monitored in detached leaves after inoculation with *Pseudomonas syringae* pv tomato DC 3000. *AtPLA IIA* and *AtPLA IIB* overexpressing, suppressing and wild type plants showed HR responses after 3-3.5 hrs, 6-6.5 hrs and 6-7 hrs of pathogen inoculation respectively. Extensive spread of necrotic lesions was observed in all the genotypes after 24-36 hrs, but severe necrotic lesions were observed in overexpressing lines. Overexpression of *AtPLA IIA* and *AtPLA IIB* genes have led to an accelerated and intense induction of HR while antisense mediated suppression of the genes have led to relatively slow induction of HR. The results revealed that constitutive overexpression of *AtPLA IIA* and *AtPLA IIB* in transgenic *Petunia* enhances the HR towards *Pseudomonas syringae* attack. It can be postulated that *AtPLA IIA* and *AtPLA IIB* are involved in signal transduction pathway leading to the HR.

**Keywords:** *Arabidopsis*, hypersensitive response, *Petunia*, phospholipase A, signalling

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## Identification of interspecific hybrid progenies in sugarcane crop improvement

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Identification of true interspecific hybrid progenies is important to produce commercial sugarcane varieties. Four interspecific hybrid families with 12 progenies each of *Saccharum officinarum* and *Saccharum spontaneum* established in the field in January 2017 were evaluated at the Sugarcane Research Institute, Uda Walawe to identify true hybrids to utilize them in back cross program in sugarcane variety improvement. The characteristics; stalk length, stalk diameter, number of millable stalks per clump, field brix, rind hardness, number of internodes per stalk and stalk weight per clump recorded from each progeny were used for identification of true hybrid progenies. Analysis of variance of the characteristics for hybrid families revealed that there is a sufficient variability among families to undertake family selection. There were significant differences among hybrid families for number of internodes per stalk, field brix, rind hardness, number of stalks per clump, leaf length and leaf width. The family 2 produced by the interspecific cross between Korpi (*S. officinarum*) and IS 76 219 (*S. spontaneum*) has been found superior to other interspecific families in directional breeding of sugarcane. Transmission of characteristics to hybrid progenies by the parents determined through narrow sense heritability was high for field brix (0.88) and rind hardness (0.82) and moderate for leaf width (0.68) and number of internodes per stalks (0.64). There were 10 progenies identified based on the result of cluster analysis as true hybrids progenies for use in the future back crosses in sugarcane crop improvement.

**Keywords:** Hybridization, Hybrid identification, Inter-specific hybridization, Sugarcane

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## **Molecular identification of the causal agent of horse hair blight *Marasmius crinis-equi* in tea (*Camellia sinensis*)**

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Horse hair blight (HHB) prevails in tea plantations of Sri Lanka below 1200 m altitude, and it has been reported from a wide range of host plants including tea. HHB forms black, horse hair-like network on the canopy of the affected tea bush. Although there are no records supporting HHB as a pathogen in tea plants, its fungal network directly interferes plucking, pruning and other agronomic practices during tea cultivation. The causal agent of HHB in tea had been previously identified as *Marasmius crinis-equi* (Basidiomycetes) by using morphological characters. However, identification of HHB fungus under *in-vitro* conditions is always difficult as the fungus does not produce conidia or any other distinctive structures in culture. Therefore, the aim of the present study was to confirm the identity of HHB fungus by DNA sequencing. DNA was extracted both from pure cultures of HHB established from rhizomorphs (strands) as well as fruit bodies collected from the field. Polymerase chain reaction was conducted for four samples using universal primers, ITS1 and ITS4-B which amplifies internal transcribed spacer (ITS) region of the 18S-26S nuclear ribosomal DNA. During the BLAST search, DNA sequences of the resultant ITS amplicons (approximately 850 bp) showed 96-97% identity to *Marasmius crinis-equi* at nucleotide level. Thus, the ITS sequence-based identification confirmed the phenotypic identity of HHB causal agent as *Marasmius crinis-equi*. Further, the identity of pure cultures of HHB was possible only by adopting sequence based identification approach.

**Keywords:** Horse Hair Blight, Sequence-based identification, *Marasmius-crinis equi*, Tea

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## **Mottle disease in passion fruit: causal agent and selection of resistant plant lines**

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Commercial cultivation of passion fruit (*Passiflora edulis*) is becoming a growing industry in Hambantota, Galle and Kalutara districts in Sri Lanka due to increasing demand from industry for processing. Recently, a previously unreported severe mottling on yellow passion fruit was reported from the Fruit Research and Development Institute in Horana. Mottling was observed only on the fruit skin while fruit size appeared normal compared to symptomless fruits. Objectives of this study were to screen the symptomatic passion fruit plants for association of any viruses with the disease and select passion fruit lines exhibiting resistance to the disease. Crude sap extracted from leaves of symptomatic vines was serologically tested using enzyme-linked immunosorbent assays (ELISA). ELISA confirmed that the causal agent belongs to the genus *Potyvirus* and serologically related to Sri Lankan passion fruit mottle virus (SLPFMV). Reverse transcription polymerase chain reaction was conducted using total RNA extracted from leaf tissues of symptomatic vines. Due to the unavailability of SLPFMV sequences on the database for primer designing, a pair of degenerate primers for potyviruses (PNIbF5, PCPR1) which amplifies a region between coat protein and nuclear inclusion b protein was used. Sequencing of an amplicon of approximately 500 bp did not match to any sequence on the NCBI/GenBank. A disease index was prepared by visual observation of fruits and rating of symptom severity. Comparison of disease index and ELISA showed that there is no correlation between symptom severity and virus titer. Passion fruit lines that rated zero percentage disease index but containing high virus titer were identified as plant lines that exhibited high resistance for mottling.

**Keywords:** ELISA, mottling, *Potyvirus*, RT-PCR, resistance

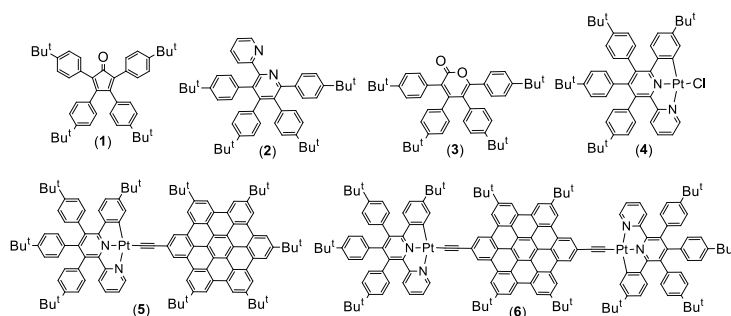
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## Synthesis of hexabenzocoronene based (NNC)Pt(II) acetylides

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Hexa-*peri*-hexabenzocoronenes (HBCs) provide a unique polyaromatic moiety for application in molecular electronic devices. HBCs with cyclometallated terdentate complexes of the type (NNC)M of Pt, Ru and Ir are having promising properties of harvesting light. New HBC based *mono*-and *di*-(NNC)Pt(II) acetylides (**5**) and (**6**) were prepared by CuI catalyzed coupling reaction and obtained orange solid products in 86% and 73% yield, respectively. The ligand (**2**) (LH) was prepared by Diels-Alder reaction between (**1**) and 2-cyanopyridine with 44% yield and the lactone by-product (**3**) was obtained in 16% yield. The *ortho*-metallated square-planar platinum(II) complex [(L)PtCl] (**4**) was synthesized as a dark yellow solid in 83% yield from the reaction between (**2**) and [PtCl<sub>2</sub>(DMSO)<sub>2</sub>] in boiling chloroform. All the new compounds were characterized by IR, Mass, <sup>1</sup>H NMR and <sup>13</sup>C NMR spectroscopy. Further, the compounds (**3**) and (**4**) were confirmed by X-ray crystallography. The substitution of *tert*-butyl groups on the ligand and HBC successfully enhanced the solubility of HBC based (NNC)Pt(II) acetylides in organic solvents.



**Keywords:** Pt(II) acetylides, hexabenzocoronene, cyclometallation, lactone

**Acknowledgements:** Author wishes to thank the Trinity College Dublin for a research fellowship and Professor S. M. Draper for laboratory facilities and other support.

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## Assessment of water quality in Kattakaduwa reservoir in Southern Sri Lanka

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The land use types and water uses are very important factors to understand the variation of water quality and ecological status of a reservoir. The aim of this study was to assess the water quality in Kattakaduwa reservoir. Water samples were analyzed for pH, temperature, dissolved Oxygen, conductivity, salinity, total dissolved solids, Secchi depth, Nitrate, Phosphate, Chlorophyll-a concentration and phytoplankton from August 2017 to October 2017. Significant temporal variation ( $p < 0.05$ ) was observed for pH, conductivity, Nitrate and Euphotic zone depth among the three sites where the Site 1 was selected at an area surrounding the agricultural land, Site 2 was selected close to an aquaculture site and Site 3 was selected close to the water pumping house. The highest levels of pH ( $8.47 \pm 0.03$ ), Nitrate ( $1.85 \pm 0.10$  mg/L) and Euphotic Zone Depth ( $1.67 \pm 0.25$  m) were observed in August and the highest level of conductivity ( $0.84 \pm 0.01$  mS) was observed in September. Thirty two algal genera were identified and the most abundant phytoplankton genera were *Melosira*, *Navicula*, *Nitzschia*, *Oscillatoria* and *Pediastrum*. The pollution tolerant genera were recorded which were considered as bio-indicators according to Palmer pollution index. The values of Water Quality Index (WQI) indicated bad water quality throughout the study period. The Palmer index showed high organic pollution in August ( $26.00 \pm 1.00$ ), moderate organic pollution in September ( $14.00 \pm 2.65$ ) and probable high organic pollution in October ( $18.00 \pm 1.00$ ). Therefore, Carlson Trophic State Index (CTSI) varied significantly among the sites where the site 1 and 2 were strongly eutrophic and the site 3 was hyper eutrophic. The water quality explained that the reservoir needs proper management for its utilization.

**Keywords:** Pollution, water quality, WQI, CTSI.

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## Investigation on sawn timber export by Sri Lanka during the period 2007 to 2017

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Information on timber export is important for sustainable forest management and support market access. The study covers the analysis of timber export for a period of ten years from 2007 to 2017. The data were analyzed based on volume exported. The trends of timber export were revealed by analysis done based on timber species and country to which timber was exported. Export data were taken from Sri Lanka Custom for past 10 consecutive years. Net weight of these timbers was converted into volume in cubic meters ( $m^3$ ). The results revealed that the highest total volume of timber has been exported in the year 2017 and it was 34% of the total timber volume exported during the 10 year study period. *Hevea brasiliensis* (Rubber), *Gravillea robusta* (Sabbukku), *Tectona grandis* (Teak) and *Pinus spp*: (Pine) were the four major species exported and the amount exported under those species is 92% of the total timber export during the period.. *Listea gardneri* (Thulang), *Cocos nucifera* (Coconut), *Swietenia microphylla/ Swetenia macrophylla* (Mahogany), *Koompassia malaccensis* (Kempus), *Albizia spp*: (Mara/Rata Mara), *Michelia champaca* (Ginisapu), *Durio zibethinus* (Durian), *Eucalyptus Grandis* (Grandis), *Alstonia macrophylla* (Alastonia), *Macaran gepeltata* (Kanda) and *Terminalia arjuna* (Kumbuk) were the other timber species exported. Sri Lanka's top four sawn timber export destinations were China, India, Australia and Maldives. This accounted about 90% of total exports in past 10 years. China was the highest importer of Sri Lanka's sawn timber. Demand of China had been increasing in every year. Huge economic ascent has occurred after 2014 in sawn timber exports. This is due to the high demand for timber of Rubber from China. Overall the export of Sri Lankan sawn timber showed huge economic ascent in recent years. The trend was variable and unstable in the period considered.

**Keywords:** Sawn timber, export, trend, destination

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## Assessment of drinking water quality in Monaragala district of Sri Lanka

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Monaragala district highly suffers from water related issues due to its geographical location, natural geochemistry and low annual rainfall that are common in the Dry Zone of Sri Lanka. According to the information obtained from the Monaragala Regional Office of Health Services, Chronic Kidney Disease of Unknown etiology (CKDu) was identified as the major health issue of the region. Since past studies have revealed that the disease is highly connected with drinking water quality, this study was carried out to assess the suitability of water for drinking purpose based on the physico-chemical parameters. Total of 97 samples were collected from different water sources of 8 divisional secretariats of *Monaragala* district from September 2017 to February 2018, and analyzed for major anions ( $\text{NO}_3^-$ ,  $\text{PO}_4^{3-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^-$ ) and cations ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ). Chemical analysis showed that Sodium and Calcium are the dominant cations, while bicarbonate and chloride are the dominant anions in the region. According to the Sri Lanka Standards 614-2013 for potable water, the highest desirable levels of total hardness (250 mg/l), total dissolved solids (500 mg/l) and electrical conductivity (750  $\mu\text{S}/\text{cm}$ ) were exceeded by the 39%, 49% and 42% of groundwater samples respectively. Up to 5.65 mg/l of fluoride were noted and 46% of the groundwater samples exceeded the highest desirable level (1.0 mg/l) while 28 % of samples exceeded the maximum permissible level (1.5 mg/l). The higher levels of total hardness and fluoride indicate the relationship between groundwater quality and natural geochemistry of the region. The groundwater in the area should be treated before using for drinking purpose.

**Keywords:** Dry zone of Sri Lanka, physico-chemical parameters, groundwater, water quality

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## **Removal efficiency of hexavalent chromium by three bacterial species isolated from chromium containing industrial effluent**

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Bioremediation of hexavalent chromium is an economically and environmentally friendly approach. In this study three species of bacteria *Micrococcus variance*, *Pseudomonas aeruginosa* and *Bacillus circulance* which were previously isolated from chromium containing effluent, were used to test their Cr(VI) removal efficiency. The removal percentages were tested using 5, 10, 20, 30, 40 mg/L concentrations of Cr(VI) in tris minimal medium. Diphenylcarbazide assay was used to determine the remaining Cr(VI) concentrations by measuring absorbance at 540 nm wavelength spectrophotometrically. According to results *Bacillus circulans* demonstrated the highest removal percentages of 98.16%, 78.49 %, 35.67%, 17.06%, and 5.23% for the concentrations of 5, 10, 20, 30, and 40 mg/L of Cr(VI) respectively. Moderate removal percentages of 95.64%, 54.96%, 33.57%, 11.74% and 1.98% were shown, respectively by *Pseudomonas aeruginosa*. The Lowest Cr(VI) removal percentages were observed for *Micrococcus variance* with the values of 92.26%, 45.72%, 27.69 %, 8.38% and 0.3% respectively.

**Keywords:** Chromium contamination, Cr (VI) removal, bioremediation

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## ***In vitro* study to assess the free radical scavenging ability of added natural iron chelators in diet**

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Free radical mediated damages are predominant in beta thalassemia patients who suffer from transfusional iron overload condition. Iron chelators have the ability to bind with free, reactive, excess iron in the body to minimize the reduction of ferrous ions that leads to the production of hydroxyl radicals. However, the synthetic chelators that are given to minimize damages are expensive and their continuous intake may result in adverse side effects. This study was carried out to assess the feasibility of incorporating potential food sources rich in natural iron chelators to the diets to minimize the free radical mediated damages through stimulated digestion models. The natural iron chelators used are rich of plant phenols resembling chelating drugs. Fifteen (15) diet plans were formulated based on four ingredients namely, red rice, fresh milk, turmeric and black tea that are rich in natural iron chelators against a control diet (no iron chelator source). The formulated diets were digested by an *in vitro* method using the stimulated gastrointestinal conditions. The effect of free radical scavenging ability of the obtained digesta was comparatively tested using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. The results showed that free radical scavenging ability had a significant ( $p$  value < 0.05) positive correlation with the total phenolic content of the digesta. Therefore, it could be concluded that incorporating food sources rich in natural iron chelators to the diet can increase the oxidative potential of the diet and minimize the free radical mediated damages under *in vitro* conditions.

**Keywords:** Free radical scavenging ability, iron overload, natural iron chelators, stimulated digestion

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## **Antiuro lithic properties of the leaf extracts of *Kalanchoe pinnata* (Akkapana)**

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Kidney stone disease is a significant health issue in the world. More than 60% of kidney stones compose of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  and  $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ . In this study, the effect of aqueous Akkapana extract on the crystallization and the dissolution of calcium oxalate crystals were investigated in supersaturated and artificial urinary circumstances in order to understand the effect of Akkapana extract on calcium oxalate kidney stone. Aqueous solutions of 8 mM  $\text{CaCl}_2$  and 125 mM  $\text{Na}_2\text{C}_2\text{O}_4$  were mixed to prepare the supersaturated solutions. Akkapana extract was obtained by grinding leaf with deionized water. Different volumes of the Akkapana extract were separately added to the prepared supersaturated solutions and artificial urinary solutions. The pH of the solution was adjusted to 7.3 and the crystal deposition process was monitored by UV-vis absorption and conductivity measurements. The crystals formed were characterized by FT-IR, XRD, TGA and redox titrations. A kidney stone collected from a patient was also treated with akkapana extracts. According to the analysis, Akkapana has an inhibition effect in the supersaturation solution and in artificial urinary circumstances showing 8% and 4% decrease in crystal deposition, respectively with 80 mL of Akkapana compared to positive control experiments. The proteins present in the extract may be reducing the crystal aggregation thus improving inhibition effect by attaching to the crystal surface and acting as a barrier for further attachment. The dissolution effect of Akkapana is far more superior to the inhibition effect. Akkapana treated sample showed 31% dissolution of calcium oxalate crystals, whereas the control experiment under the same conditions, showed approximately 18% dissolution. The kidney stone of the patient showed ~18% dissolution with four 300 mL washings of Akkapana extract. This could be due to strong binding of  $\text{Ca}^{2+}$  ions with the organic acids and amino acids present in Akkapana, and forming water soluble complexes.

**Keywords:** Calcium oxalate, Akkapana, inhibition and dissolution effect

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## Role of some selected organic acids on kidney stone formation and dissolution

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Kidney stone disease has attracted considerable interest among scientists as one of the most important non-communicable diseases. Approximately 20% of the population has affected by kidney stones. Kidney stones are collection of microcrystalline biomineralized materials, mainly containing calcium oxalate monohydrate (COM) or dihydrate (COD), either alone or combined. Even though the kidney stone disease is a global health issue, a few therapeutic protocols are effective to treat kidney stones. The current study investigated the effect of some selected organic acids on calcium oxalate kidney stone formation and dissolution in synthetic urine and in supper saturated solutions. The organic acids used were malic acid, parahydroxybenzoic acid, syringic acid, caffeic acid and citric acid. Aqueous solutions of  $\text{CaCl}_2$  and  $\text{CaC}_2\text{O}_4$  were combined together at pH 7.3 to prepare the calcium oxalate supper saturated solutions. To simulate the natural urine conditions for the experiments, typical standard reference artificial urine solutions were prepared. Varying amounts of individual organic acids and their mixtures (1-10 mg range) were separately added to the supper saturated and synthetic urine solutions. The crystal deposition kinetics were monitored by conductivity measurements. The formed crystals were characterized by FTIR, XRD, SEM and redox titrations to determine the structure and the morphology of calcium oxalate crystals formed. In all experiments, the formed crystals were mainly consisted of thermodynamically more stable COM. The inhibition activity of organic acid varies in the order of malic acid (3.2%) < caffeic acid (4%) < syringic acid (6.2%) < acid mixture (10%) < parahydroxybenzoic acid (10.6%) and citric acid (18.82%) in synthetic urine solutions. Parahydroxybenzoic acid showed the second highest inhibition effect compared to the known citric acid due to the formation of stable calcium salt. However, the percentage inhibition observed for acid mixtures closely represent the sum of percentage inhibition showed by individual acids (~10.0% vs 11.4%). That means acid mixtures do not exhibit synergistic behavior either in synthetic urine or in supersaturated solutions.

**Keywords:** calcium oxalate, organic acids, kidney stones inhibition and dissolution effect

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## Isolation and physicochemical characterization of sour orange pectin

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Sour orange (*Citrus aurantium* sp.) has not been explored sufficiently as a potential source of pectin, and its peel as a waste from fruit juice industry has been recently under investigation as a potential low-cost source of pectin. In the present work, pectin was efficiently extracted in moderately high yield from sour orange peels in acidic medium, which was not explored for the same raw material before. Chemical confirmatory tests were carried out to identify the characteristics of the isolated pectin. The isolated pectin has mainly glycosides with gel-forming properties and free from starch and non-reducing sugar. Qualitative tests were carried out to study the solubility of pectin in hot/cold water and hot/cold alkali, and it was found that the solubility of sour orange pectin is similar to that of commercial citrus pectin. Equivalent weight, methoxyl content, anhydrouronic acid content and degree of esterification were determined by titrimetric methods. Low degree of esterification (<28.6%) made it evident that the sour orange pectin is a low-methoxyl pectin. According to X-Ray Diffraction (XRD) analysis, sour orange pectin was found to be amorphous by nature. FTIR spectra of isolated pectin revealed the existence of functional groups such as amide, alcohol, carbohydrate ring, unsaturated ester, carboxylic acid, aliphatic amine and alkyl halide, and isolated sour orange pectin was identified as amidated pectin

**Keywords:** Anhydrouronic acid content, degree of esterification, pectin, sour orange

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## Use of chemically modified *Macaranga indica* leaf powder for the removal of methylene blue from aqueous solutions

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One of the common contaminants of industrial wastewater is dye pollutants that come from textile, paper and leather industries. Currently much attention has been paid in utilizing low cost biosorbents for dye removal in wastewater. The feasibility of utilizing *Macaranga indica* (MI) leaf powder as a potential adsorbent for the removal of methylene blue (MB) was investigated in this study. The parameters such as contact time and pH were optimized for the determination of adsorption capacity of MI leaf powder. The surface characterization of the adsorbent was carried out by determining the point of zero charge ( $pH_{pzc}$ ) values. Possible enhancement of adsorption capacities was investigated by the chemical modification which is one of the most outstanding and efficient techniques used to enhance the surface properties of biosorbents. NaOH and EDTA were used for chemical modification of MI leaf powder and the maximum adsorption capacities were determined. The maximum adsorption capacities for unmodified MI leaf powder and its NaOH and EDTA modified forms were 12.31, 149.25 and 250.00 mg/g respectively. The extent of the adsorption of MB by the unmodified and modified MI leaf powder was influenced by ionic constituents in the medium and pH. Langmuir and Freundlich models were used to describe the adsorption process. The results revealed that dry powder of MI leaf is a very efficient low cost potential biosorbent for the removal of MB and similar cationic dyes from aqueous solutions such as wastewater.

**Keywords:** Biosorbent, *Macaranga indica*, Chemical modification, Methylene blue

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## UV absorbing properties of extracts obtained from *Canna* flowers grown in Sri Lanka

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In this study, the UV absorbing properties of extracts of *Canna* flowers were evaluated using spectroscopic techniques and Mansur equation. The methanol and methanol: distilled water (1:1) extracts of red and yellow *Canna* flowers were analyzed for their SPF (Sun Protection Factor) by measuring UV absorbance of different concentrations in methanol. Dermatone® was used as a reference agent. Absorption data were obtained in the range of 290-320 nm, at every 5 nm and the SPF values were determined. All the extracts showed substantial UV absorbing abilities in the UVB region. The methanolic extract of *Canna* red flowers ( $0.8 \text{ mg mL}^{-1}$ ) has the highest mean SPF value  $24.34 \pm 0.02$ . All concentration series (0.2, 0.4, 0.6, 0.8 and  $1.0 \text{ mg mL}^{-1}$ ) of *Canna* red flowers have  $\text{SPF} \geq 6$ . Phytochemical screening of crude methanolic extract of *Canna* red flowers revealed the presence of diterpenes, alkaloids, flavonoids, phenols and glycosides. These components were separated by Preparative Thin Layer Chromatography (PTLC). Flavonoid fraction from PTLC showed the highest mean SPF value of  $13.66 \pm 0.05$ , while diterpenes, alkaloids, phenols and glycosides have the values of  $6.56 \pm 0.03$ ,  $0.11 \pm 0.03$ ,  $11.60 \pm 0.09$  and  $2.60 \pm 0.08$  respectively. The reference agent Dermatone® had SPF value of  $25.72 \pm 0.32$ . The results of this study indicate that the methanolic extract of *Canna* red flowers absorb the UVB radiation and possess sun protection ability against UVB radiation. The active components responsible for UV absorption could be isolated and used in sunscreen formulations.

**Keywords:** Sun Protection Factor, UVB radiation, sunscreen

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## **Incidence of post dural puncture headache among mothers following caesarean section under spinal anesthesia at the General Hospital Kegalle, Sri Lanka**

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Post Dural Puncture Headaches (PDPH) is a known complication of spinal anesthesia. Pregnant mothers who delivered their babies following spinal anesthesia especially suffer from this disturbing condition. Objective of this was to determine the incidence of PDPH among mothers who had caesarean sections in General hospital Kegalle. A descriptive cross sectional study was conducted involving all post natal units at General Hospital (GH), Kegalle. All the mothers who had spinal anesthesia during caesarean sections over 8 month period were considered as the study population. A case of PDPH is defined as a mother who complained a new onset headache following 12 hours gap after performing spinal anesthesia (onset between 12-48 hours). Two study instruments were used; a data sheet to extract relevant information from medical records and an interviewer administered questionnaire to elicit experience of mothers. Study population consisted of 422 mothers who had spinal anesthesia over a period of 8 months with a mean age of 30.6 (SD 5.9). Only Fifty seven (13.5%) reported PDPH. Commonest co-morbidity was neck pain (68.4%) followed by nausea (49.1%). Among them 21 (36.8%) had past history of headache. Six (10.5%) mothers with PDPH had pregnancy induced hypertension while 4 (7.0%) had GDM. Most of them got down from bed after 6 hours (73.2%). Among those PDPH, majority had spinal anesthesia with a needle of 24 G (92.8%), and among 95.6%, it was performed by a medical officer and in most of those instances performing person had an experience of 1-3 years in anesthesia. Experience less than 1 year was significantly associated with the development of PDPH ( $p < 0.01$ ). Prevalence of PDPH was 13.5% and commonest comorbidity was neck pain. Risk was more with less experienced performers.

**Keywords:** Post dural puncture headache, spinal anesthesia

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## Detection of antimicrobial resistant genes of bacteria isolated from Bovine Mastitic milk by PCR

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Bovine mastitis is a major problem in dairy industry resulting in heavy economic losses. Treatment effectiveness is often hindered by the emergence of antimicrobial resistance among bacteria causing mastitis. The present investigation aimed to detect the resistant genes in bacteria isolated from mastitic milk considering the commonly used antimicrobials. Genomic DNA was extracted from 19 coliforms and 11 Staphylococci isolates by a commercial kit. PCR was performed using specific primers with the sequence of F-TCGCCTGTGTATTATCTCCC and R-CGCAGATAAA-TCACCACAATG for *bla<sub>SHV</sub>* gene responsible for beta-lactam resistance and F-GGTTCACCTCGAACGACGTCA and R-CTGTCCACAAGTTG-CATGA for *tet(A)* gene involved in tetracycline resistance. Of the 30 tested isolates, 80% (24) and 46.7% (14) were positive for *Bla<sub>SHV</sub>* and *tet(A)* gene respectively. Among the phenotypically resistant 20 isolates, *tet(A)* gene was not present in six isolates. Ninety six percent of 25 phenotypically resistant isolates carried *bla<sub>SHV</sub>* gene. In all isolates carrying *tet(A)* gene, *bla<sub>SHV</sub>* gene was present. High frequency of resistant genes highlights the need of novel therapeutic strategies for mastitis. Further molecular surveillance is recommended for improved control measures.

**Keywords:** Antimicrobial resistance, bovine mastitis, *Bla<sub>SHV</sub>*, *tet(A)*

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## **Composition and distribution of Avifaunal diversity in the premises of the University of Kelaniya, Sri Lanka**

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The study assessed the variation in landscape towards the composition and distribution of avifauna in University of Kelaniya premises. Study was conducted selecting 8 habitats types as open ground, low, moderately and highly wooded using purposive sampling representing different habitats. Survey was conducted during the period of 05.30hr- 6.30hr and 17.30hr-18.30hr time of October 2016 to December 2016 ensuring six sampling occasions at each habitat. Point counting method (15 m radius) was used. Species diversity parameters, species distribution among habitats were analyzed using Kruskal-Wallis test, while Principle Component Analysis (PCA) was used to characterize the habitats with bird species. Species richness ( $r=27$ ) and species diversity ( $H'=3.09$ ) were the highest in habitat number 4 while species evenness ( $J=2.24$ ) was highest in habitat number 3. Total abundance ( $n=75$ ) was recorded in habitat number 1. According to the Kruskal-Wallis statistical results, Asian brown flycatcher (Habitat 1, 3, 4, 5, 7) and White bellied drongo (Habitat 1, 4, 5, 7 and 8) were recorded as widely distributed. The second largest distribution was recorded by Black hooded oriole, Blue tailed bee-eater, Cattle egret, Feral pigeon, Brown headed barbet, Red vented bulbul, Rose ringed parakeet, within four habitats. According to the PCA, habitat 1 is categorized by open grassland birds while habitat 4 is characterized by frugivorous birds while site 5 is characterized by carnivorous birds. Comparatively, habitat 4 contributes to the highest species diversity with many flowering and fruiting trees. Recorded avifaunal community composition ensures considerable conservation value to University premises of Kelaniya.

**Keywords:** bird diversity, avifaunal conservation, species richness.

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## **Nest construction scenario of Sri Lanka yellow-eared bulbul (*Pycnonotus penicillatus*) in tropical montane cloud forests of Horton Plains**

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Sri Lanka yellow-eared bulbul (*Pycnonotus penicillatus*) is an endemic threatened bird occupying higher elevations above 900 m. The study aimed to determine nest construction strategies of *P. penicillatus* in the Tropical Montane Cloud Forests. The research was conducted at Horton Plains National Park (HPNP) of Sri Lanka from September 2015 to August 2018. Nests of *P. penicillatus* were located by following breeding pairs and searching the vegetation. Measurements of the nests were taken using a Vernier Calliper. Volume of the nest cup and material volume in the nest was calculated and nest orientation within the nesting tree was measured using a compass. To identify and quantify nesting materials, three nests were collected after the breeding season. In this study, 38 nests were recorded. *P. penicillatus* abstained 5 to 7 days to complete the nest. Both sexes participated to build the nest. External diameter of the nest was  $12.01 \pm 0.55$  cm (Mean  $\pm$  SD). Nest cup volume and nest material volume were  $101.72 \pm 15.63$  cm<sup>3</sup> and  $527.90 \pm 74.60$  cm<sup>3</sup> respectively. Maximum numbers of nests were located in North and East directions (8 nests in each direction). They used leaves (35%), moss (20%), lichens (10%), small twigs (10%), roots (10%), and threads (15%) as nest building material. The nest was comprehensively different from other bulbul nests with distinctive nest size and peculiar preference of nest materials. There were no synthetic nesting materials observed within HPNP. Moreover, they have used materials from endemic plants. This research will guide the management approaches to protect breeding habitats of *P. penicillatus* correspondingly.

**Keywords:** Endemic birds of Sri Lanka, Horton Plains National Park, nest construction, *Pycnonotus penicillatus*, tropical montane cloud forests.

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## **Comparative study on extraction methods of Astaxanthin from shrimp waste**

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Astaxanthin (AST) is a natural pigment that is responsible for the pink-red color of crustaceans and fish. Astaxanthin is widely used in food, medical, cosmetic and biotechnological and ornamental fish industries. Discarded shrimp waste from processing industries could be a good source of AST. Present study compared the efficiency of extraction of AST from shrimp shell wastes by two methods; direct autolysis and autolysis of microwaved shrimp waste samples. In both methods of autolysis, shrimp waste samples were mixed with fresh crab wastes according to the following shrimp: crab ratios of weights in grams; 20:20, 40:20, 60:20, 80:20, and 100:0. All the samples were autolyzed at 60°C for 20 min. and filtered. Filtrate and residue were dried. AST in all filtrates and the residues were extracted using hexane, and quantified by measuring absorbance at 470 nm. Concentration of extracted AST by the two methods were compared by analysis of variance (ANOVA) ( $p < 0.05$ ). Maximum ( $38.45 \pm 0.94 \mu\text{g/g}$ ) and minimum ( $9.31 \pm 0.65 \mu\text{g/g}$ ) AST concentration of the dried filtrate were recorded in 40:20 and 20:20 autolyzed fresh shell fish samples respectively. Concentration of AST is significantly different in two methods in all shrimp: crab ratios studied. In both methods AST concentration increased up to shrimp: crab ratio 40:20 and then with further increment of shrimp content it gradually decreased except 80:20 ratio of microwaved method. AST concentrations of all the residue samples were zero. Results indicate that fresh sample autolyzed method gives higher concentration of AST than microwaved autolyzed method. The ratio of 40:20 shrimp: crab waste is the best combination to obtain high amount of AST yield.

**Keywords:** Astaxanthin extraction methods, Shrimp waste, Shell fish autolysis

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## **Intertidal macrofaunal and macroalgal diversity in the Southern coastal belt of Sri Lanka**

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Southern coastal belt in Sri Lanka is characterized by unique ecosystems providing secure habitats for intertidal floral and faunal communities. Biodiversity assessment of these communities is important for recognizing ecosystem changes in coastal environment prior to implementing management and conservation programmes. A biodiversity survey on the intertidal invertebrates and macroalgae along this coastal belt was carried out using systematic aligned sampling method. The sampling was made from the uppermost part to low waterline of the intertidal zone at 12 selected beaches (i.e. Hambantota, Godawaya, Rekawa, Tangalle, Dickwella, Polhena, Mirissa, Weligama, Unawatuna, Galle fort, Dodanduwa and Hikkaduwa) covering 3 Districts (Hambantota, Matara, Galle) along the coastline during July-October 2018. The sampling sites were selected by preliminary investigation considering commercial importance such as the recreational and fishery activities. According to the results, Shannon-Wiener diversity index ( $H'$ ) ranged from 1.61 to 2.86. Biodiversity of the respective ecosystem is spatially varied significantly ( $p < 0.05$ ). Overall results indicated 44 species belonging to Phylum Arthropoda, Mollusca, Echinodermata, Coelenterata, Porifera, Division Chlorophyta, Rhodophyta and Phaeophyta. Macroinvertebrates in Phylum Mollusca (> 50% of species richness) and macroalgae in Division Chlorophyta (> 16% of species richness) dominated the invertebrate and algal components of the intertidal community respectively. The findings of the current study could be used as baseline data when implementing coastal conservation programmes along the Southern coastal region.

**Keywords:** Biodiversity assessment, coastal invertebrates, intertidal zone, macroalgae, Shannon-Wiener diversity index

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## **Molecular evidence for revalidation of synonyms *Systemus spilurus* and *Systemus timbiri* (Cyprinidae) as two separate species in Sri Lanka**

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*Systemus sarana* (Pisces: Cyprinidae) is described from India and is believed to be widely distributed in the South Asian region including Sri Lanka. The taxonomic status of the species identified previously as *S. sarana* in Sri Lanka is ambiguous. There are two available names for this fish in Sri Lanka, i.e. *Systemus spilurus* and *Systemus timbiri* yet the affirmative use of these two names require validation through phylogenetic evidence. No previous molecular studies had been carried out for this species, therefore, the present study aimed to find molecular evidence through DNA barcoding to reveal *Systemus* diversity in Sri Lanka. Partial mitochondrial COI gene sequences were analysed from *S. sarana* like fishes from several geographic locations, and a sequence comparison was carried out to determine if the Sri Lankan specimens are identical to or different from Indian specimens. BLAST search did not yield any GenBank sequence with 100% similarity to the submitted Sri Lankan sequences suggesting that the Sri Lankan specimens cannot be similar to the Indian *S. sarana*. According to the derived molecular phylogenetic tree, the specimens from Sri Lanka were separated from Indian *S. sarana* with more than 98% bootstrap support and the Kimura 2-parameter (K2p) divergence levels ranging from 2.9% to 4.6% between them. This indicates that the species available in Sri Lanka is clearly a separate lineage from *S. sarana* (India). Furthermore, Sri Lankan specimens were clustered in to two clades with K2p ranging 2% - 2.2% divergence. The first clade (A) represented the specimens from Walawe River, Nilwala River, Kirindi Oya and Menik River, while the second clade (B) consisted of Kalu River, Kelani River and Gin River. Considering the type locality of *S. timbiri* (Walawe River), it can be suggested that the Clade A represents *S. timbiri*. Clade B is proposed to be the other species *S. spilurus*. The results of this study give molecular evidence for revalidating the names of *S. spilurus* and *S. timbiri* for the species that was long misnamed as *S. sarana*. Morphological comparison among relevant type specimens will be further needed to confirm this phylogenetic identification.

**Keywords:** Mitochondrial COI sequence, molecular divergence, phylogenetic tree, *Systemus sarana*

**Acknowledgements:** Authors wish to thank for financial support of TURIS/Pro 70.

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## **Evaluation of total phenolic, flavonoid contents and *in vitro* antioxidant activity of different solvent extracts obtained from *Canna* (red) flowers grown in Sri Lanka**

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The aim of the present study was to evaluate total phenolic, flavonoid contents and *in vitro* antioxidant activity of four different solvents [acidified 70% aqueous acetone (AAD), 70% aqueous acetone (AD), acidified 80% aqueous methanol (AMD) and 80% aqueous methanol (MD)] extracts obtained from *Canna* (red) flowers. The crude extracts were prepared by steeping method in the dark conditions from oven dried *Canna* (red) flowers collected from Galle district in Sri Lanka. The freeze dried powders of crude extracts were subjected to preliminary phytochemical tests. The total phenolic and flavonoid contents and *in vitro* antioxidant activity of the four different extracts were evaluated by Folin-Ciocalteu assay, aluminium chloride colorimetric method and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay respectively. The results of the preliminary phytochemical screening exhibited the presence of phenolic compounds, flavonoids, quinones, carbohydrates, reducing sugars and saponins and absence of alkaloids in all four extracts. The results of the total phenolic content of the four different extracts were 5389.067±681.343 (AAD), 4172.308±333.424 (AD), 4624.662±255.258 (AMD) and 4195.533±342.593 (MD) mg Gallic acid equivalent (GAE)/100 g dry weight (DW) of flowers. Total flavonoid content of the four different extracts were 6017.442±158.343 (AAD), 3023.633±450.899 (AD), 2973.658±233.448 (AMD) and 2205.822±379.418 (MD) mg Catechin equivalents (CAE)/100 g DW of flowers. Antioxidant capacity of the four different extracts were 17.430±2.673 (AAD), 15.401±2.452 (AD), 16.512±1.440 (AMD) and 14.752±3.154 (MD) mmol Trolox equivalents/100 g DW of flowers. The results indicated that acidified 70% aqueous acetone extract of *Canna* (red) contains significantly high total phenolic and flavonoid contents as well as promising antioxidant activity.

**Keywords:** Antioxidant activity, canna, total favonoid content, fotal phenolic content

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## **Macronutrient intake of national level athletes engaged in leanness and non-leanness sports**

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Nutrient intake is a significant factor affecting the performance of athletes. In most of the weight-category sports, athletes tend to fluctuate their body weight by altering their diets to achieve competition goals. The aim of this study was to determine the differences between national level athletes engaged in leanness and non-leanness sports with respect to macronutrient intake. This research was a cross-sectional survey and stratified random sampling method was used to select the sample which included 265 national level athletes representing 10 different sports (134 from leanness sports, 131 from non-leanness sports). The selected leanness sports were Karate, Weightlifting, Judo, Wrestling and Boxing. Non-leanness sports included Baseball, Volleyball, Rugby, Hockey and Football. The 24-hour dietary recall method was used to gather information about daily food intake of participants. Diet records were converted to daily nutrient intake values based on food composition tables. Mann Whitney U test was carried out to determine the differences in macronutrient intakes of athletes engaged in leanness and non-leanness sports. According to the results, the majority of athletes reached the acceptable macronutrient distribution ranges (AMDR) for carbohydrates (84%), proteins (96%) and fat (80%). Nevertheless, daily energy, carbohydrate, protein and fat intake values of athletes engaged in leanness sports were lower ( $p < 0.05$ ) than those of athletes engaged in non-leanness sports. The study identified some differences in nutrient intake among Sri Lankan national level athletes engaged in leanness and non-leanness sports and suggests a need for developing strategies in counseling and teaching of athletes to improve their nutrient intake.

**Keywords:** Leanness athletes, macronutrient intake, non-leanness athletes

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## **Formulation of mosquito repellent herbal cream using flower extract of *Tagetes erecta* (marigold) and evaluation of its in vitro mosquito repellent activity against *Aedes aegypti*, *Anopheles stephensi*, *Culex quinquefasciatus***

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The aim of the present study is to formulate mosquito repellent herbal cream and evaluate its *in vitro* mosquito repellent activity against *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus*. Oil in water emulsion based 5% w/w active ingredient cream was formulated by using fresh flower extract of marigold and observed for physical stability parameters (pH, appearance, washability and colour) for 45 days at room temperature. The mosquito repellent efficacy of the cream was tested by applying 1 g of herbal cream formulated on the dorsal hand area (25 cm<sup>2</sup>) of one person of the trained panel. The treated hand and untreated hand (negative control) were exposed to 100 caged, blood-starved, laboratory bred female mosquitoes of three species and repellency test was performed for 300 min. and numbers of mosquitoes sitting on the hand were counted at every 30 min. The formulated cream was found to be homogenous, semi-solid, washable and yellow colour and pH was in the range of 6-7. Total protection without sitting or biting of all three species of mosquitoes were recorded up to 180 minutes for formulated cream and percentage of repellency was calculated as 95.405± 6.042%. A commercial herbal cream was tested as positive control and it was protected from mosquitoes sitting or biting up to only 30 minutes and repellency percentage was 46.677± 41.335%. The results showed that the cream formulated with extract of *Tagetes erecta* fresh flowers had the potential mosquito repellent activity against *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus* bites.

**Keywords:** *Aedes aegypti*, *Anopheles stephensi*, *Culex quinquefasciatus*, *Tagetes erecta*, mosquito repellent

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## **Anti-bacterial activity of novel gel formulations prepared with seed extracts of *Coriandrum sativum* L. and *Nigella sativa* L. against *Staphylococcus aureus***

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Acne vulgaris is a chronic dermatologic condition with a complex pathogenesis which involves inflammation of pilosebaceous units (hair follicles and their accompanying sebaceous gland). It is generally characterized by the presence of *Propionibacterium acnes*, an anaerobic bacterium that mostly resides in the pilosebaceous follicles of the skin and *Staphylococcus aureus* infection, inflammation, seborrhea and follicular hyperproliferation. Spices like seeds of *Coriandrum sativum* L. and *Nigella sativa* L. are known to produce phytochemicals that exhibit antioxidant action and anti-bacterial effect and consequently may have propitious activity against inflammatory acne caused by *S. aureus*. The objective of this study was to determine the MIC (minimum inhibition concentration) and MBC (minimum bactericidal concentration) values of the face gels against *S. aureus*. Six gel bases were prepared by using carbapol 940, phenoxy ethanol, EDTA, rose water, poly ethylene glycol and triethanolamine. The seed extracts of *C. sativum* and *N. sativa* were combined into the gel bases at predetermined strengths. The MIC and MBC values were determined by broth micro-dilution and direct plate on agar methods respectively. All six face gels combined with the seed extracts of *C. sativum* and *N. sativa* exhibited very potent anti-bacterial effect against *S. aureus*. The MIC values of the face gel series were observed as 62.5-250 µg/mL and MBC values were determined as 125-500 µg/mL. The observations demonstrate that all six face gels exhibited potent anti-bacterial effect against *S. aureus* and this effect of the face gels becomes greater when the proportion of the seed extract in the formulation increases.

**Keywords:** *Coriandrum sativum* L., micro dilution, minimum inhibition concentration, *Nigella sativa* L., *Staphylococcus aureus*

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## **Antimicrobial efficacy of novel alcohol-based hand scrubs with clove oil, cinnamon oil and aloe vera leaf extract against *Acinetobacter baumannii* and *Proteus mirabilis***

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Poor hand-hygiene compliance among healthcare workers leads to increase disease transmission. The aim of the study was to develop alcohol based hand scrubs using medicinal plant extracts and evaluate the antimicrobial efficacy against selected microorganisms. Two types of alcohol based herbal hand scrubs were prepared, with the combination of clove oil and leaf extract of aloe vera (F<sub>1</sub>) and combination of cinnamon oil and leaf extract of aloe vera (F<sub>2</sub>). Twenty-five health care professionals (medical laboratory technologists and research officers) at Medical Research Institute, Sri Lanka were randomly tested to identify the viable pathogens present on their hands. From the identified microorganisms, standard cultures of *Acinetobacter baumannii* and *Proteus mirabilis* were used to test antimicrobial activity of the prepared scrubs using agar well-diffusion method. The physical stability parameters (pH, odor, appearance and colour) were monitored for 90 days at room temperature. The formulated hand scrubs were found to be homogenous, liquid and milky-white in colour with a pleasant odor. The mean values of inhibition zones of F<sub>1</sub> were 20.00 ± 2.00 mm and 20.30 ± 1.53 mm against *Acinetobacter baumannii* and *Proteus mirabilis* respectively. The mean values of inhibition zones of F<sub>2</sub> were 10.00 ± 0.00 mm and 09.33 ± 1.15 mm against *Acinetobacter baumannii* and *Proteus mirabilis* respectively. No inhibition zones were obtained for the negative controls (distilled water-N<sub>1</sub>, glycerin-N<sub>2</sub>) and positive controls (70% ethanol-P<sub>1</sub>, market product-P<sub>2</sub>) against the pathogens tested. Therefore, it is concluded that the formulated alcohol-based hand scrubs are having promising antimicrobial activity against the pathogens tested.

**Keywords:** Alcohol based hand scrubs, aloe vera leaf extract, pathogens, cinnamon oil, clove oil

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## **Co-occurrence of predatory *Lutzia (Metalutzia) fuscana* larvae with *Aedes albopictus* (Diptera:Culicidae) larvae at Thitthagalla in Galle District, Sri Lanka**

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Biological control of vector mosquitoes is a very important concept in mosquito control programmes. Predatory mosquitoes are the most important biological control agents as they usually coexist with other mosquito larvae especially in natural habitats compared to urban or semi urban habitats. A survey on predatory mosquito larvae associated with vector mosquitoes was carried out in Galle District of the Southern Province of Sri Lanka. All potential breeding habitats of *Aedes albopictus* such as domestic and peri-domestic water storage containers, cement tanks, ponds, ditches and overhead tanks were examined in 100 premises in selected sites in Thitthagalla area, Galle. The containers which were positive for predatory *Lutzia (Metalutzia) fuscana* with vector *Ae. albopictus* larvae were recorded. The container index for both species were calculated and species identification of the collected mosquitoes was confirmed in the laboratory using standard taxonomic keys for mosquito adults and larvae. Weather data during the sampling periods were also recorded. Container indices of water storage cement tanks and tyres for *L. fuscana* were 50% and 32% while the respective values for *Ae. albopictus* larvae were 50% and 72%. *L. fuscana* larvae in cement containers showed positive linear correlation with temperature ( $r= 0.713$ ,  $P<0.01$ ), a negative linear correlation with relative humidity ( $r= -0.419$ ,  $P<0.01$ ) and but no linear correlation with the rain fall ( $r= -0.200$ ,  $P>0.05$ ). Predatory potential of *L. fuscana* needs to be studied further for effective biological control of *Ae. albopictus* larvae in Galle district.

**Keywords:** *Aedes albopictus*, container index, *Lutzia (Metalutzia) fuscana*

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## **The first record of three imperative jellyfish species from the coastal waters of Sri Lanka**

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Jellyfishes (Phylum Cnidaria) are important as a delicacy, ornamental animal, collagen source and bio-indicator of climatic changes. In spite of this, jellyfishes have negative impacts on fisheries and tourist industries too, where they clog fishing nets and sting recreational water users respectively. Only a few jellyfish species have been recorded from the Sri Lankan coastal waters. In the present study, jellyfish species reported in the coastal waters of Sri Lanka during January 2017 to April 2018 are presented here. From a systematic survey, jellyfishes were collected and preserved in 5% formalin for taxonomic identification. Altogether forty species were identified based on their morphological features using standard identification guides. Of these species, *Chrysaora chinensis* Vanhöffen, 1888, *Crambionella orsini* Vanhöffen, 1888 and *Chironex indrasaksajiae* Sucharitakul, 2017, were recorded for the first-time from the Sri Lankan waters. *Chrysaora chinensis* (n= 432) was found along the entire coastal belt of the country, *C. orsini* (n=5) was found from northern, northwestern and southeastern coasts while *C. indrasaksajiae* (n=4) was found only from eastern coast during the study period. Among the three species, *C. orsini* was the largest, having a bell diameter of ~200 mm, followed by *C. chinensis* and *C. indrasaksajiae* having bell diameters of ~140 mm and ~110 mm respectively. Of the three species, *C. chinensis* and *C. indrasaksajiae* are highly hazardous to human health while *C. orsini* is a harmless, edible jellyfish which is heavily fished for export market from the southeast coastal waters of Sri Lanka.

**Keywords:** *Chironex indrasaksajiae*, *Chrysaora chinensis*, *Crambionella orsini*

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## **Salivary composition of selected age groups of captive Asian elephants at Pinnawala Elephant Orphanage, Sri Lanka**

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The salivary composition of Sri Lankan elephants has not been thoroughly investigated. The present study aimed to determine the salivary composition of captive Asian elephants at the Pinnawala elephant orphanage (PEO), Sri Lanka from March to September 2017. The biochemical, physical and chemical parameters of saliva and variation of salivary composition among five study groups of captive elephants, namely, Group 1 (Pregnant, n= 6), Group 2, (Supplementary milk feeding, 00-05 yrs., n= 3); Group 3 (age 05-15yrs., n= 6), Group 4 (age 16-30 yrs., n=6), and Group 5 ( above 30 years of age, n= 3) were analyzed. Saliva samples (approx. 2.5 ml) were collected from each elephant using a sponge before and after the feeding. Samples were pooled according to the group, centrifuged and used for analysis. Variations of salivary composition namely, percentages of salivary enzymes, trace materials, cations and anions in salivary samples of study groups were compared and analysed using the standard analytical methods in the laboratory. Results showed that salivary components such as amylase, ammonia and phosphates were not varied according to their feeding time or age, however mucin is present only in 16-30 year age group. Other salivary components such as urea, glucose, chlorides, sulphates, calcium, magnesium and sodium were varied with their feeding time or age. Pregnant group had relatively low creatinine level which was 25% less than the other groups. During this study two types of microbes were observed twice in salivary samples of Group 1 and 2. The present study provides baseline information on salivary composition of captive elephants in PEO, Sri Lanka.

**Keywords:** Captive Sri Lankan elephants, Pinnawala elephant orphanage, salivary composition

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## **A time series modeling approach for forecasting gold price demands in Sri Lanka**

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The demand of the metal gold makes a significant role in the world economy. In the real world, different types of social and economic factors are directly affected on the gold demands; especially the volatility of the share market conditions are significant. The main objective of this current study is to develop high accuracy model for forecasting gold price demands to fulfill investors' expectations. Different Autoregressive integrated moving average (ARIMA) models were considered. The model selection results of Akaike information criterion (17.549), Schwarz criterion (17.575) and Hannan-Quinn criterion (17.559) suggested that, ARIMA (2, 1, 2) is the best model for forecasting daily gold prices under the volatility during the period from June 2014 to June 2017. In addition to that, the Vector Autoregression model (VAR) is used to test the effectiveness with respect to the external factors such as GDP, Real Effective Exchange rate and Broad Money. The empirical findings of Vector Autoregressive Modeling Approach suggested that, GDP and Real Effective Exchange rate highly affect for the gold price demands in Sri Lanka.

**Keywords:** Gold price, Time series Forecasting, Autoregressive integrated moving average model, Vector Autoregression model

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## **An efficient numerical scheme for time fractional reaction diffusion equations**

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The aim of this paper is to introduce a more accurate and efficient discrete fractional order derivative to integrate non-linear time fractional order reaction diffusion equations. The Fixed Memory method (Short Memory method (SMM)) and the Full Memory method (FMM) are two established discrete fractional order derivatives (DFODs). In the fixed memory method, the tail of the memory at each time step is cut off and hence uncontrollable error occurs. Also, FMM is not efficient for long time integration of large systems of fractional differential equations because of higher computational cost. To overcome these barriers, author propose a new discrete fractional order derivative. In this method, the number of memory points in the past are reduced by choosing only a part of the memory points randomly and decreasing along the tail of the memory (call this *the Decreasing Random Memory Method* (DRMM)). Author constructed three semi implicit numerical schemes, semi implicit scheme with full memory method (SI-FMM), semi implicit scheme with short memory method (SI-SMM) and semi implicit scheme with decreasing random memory method (SI-DRMM) and compare accuracies and computational costs (CT) of these three numerical schemes. To do this comparison, author applied these three numerical schemes for three fractional reaction diffusion equations whose exact solutions are known. Numerical experiments show that the error occur in proposed SI-DRMM is less than that of SI-SMM. Furthermore, SI-DRMM is computationally cheaper than the SI-FMM. Therefore, the proposed DRMM is more accurate than SMM and more efficient than FMM.

**Keywords:** discrete fractional order derivatives, time fractional reaction diffusion equations, short memory method, full memory method

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## **A computationally efficient electrocardiogram analysis system**

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Fast, portable and accurate electrocardiogram (ECG) analysis systems play a major role in the diagnosis of the cardiovascular diseases that causes a vast number of deaths each year. Even though the application of the wavelet transformation based techniques in ECG analysis systems provides very accurate QRS wave complex detection results (associated with the ventricular depolarization), they are often computationally demanding. Further they are generally too complicated to be directly implemented in portable microcontroller based battery powered systems and usually require the power of a modern computer. Thus, in this paper a new and computationally efficient wave transformation technique for discovering the QRS complexes in ECG records by obtaining the wave's first derivative and then transforming the signal using a single impulse response function (IRF) based R peak pulse (in the QRS complex) detection method is proposed and established. By using this technique, a high degree of accuracy is rapidly achieved to locate the R peaks by clearly distinguishing them from large wave distortions in the ECG signal. The analysis of the new technique was implemented using ECG records from the MIT-BIH Arrhythmia database, and then compared with a wavelet transformation based very accurate and recognized detection technique. Based on the computational time consumption comparisons the proposed method is at least faster by 350%. Further the calculated standard QRS detector performance parameters such as the sensitivity (Se) and the true prediction (+P) are comparable with the recognized method. For every ECG instance an identification error rate of less than 1% was attained. We believe that there is room for further improvements and the technique can be used in portable ECG analysis systems with a higher computational performance.

**Keywords:** Electrocardiogram, Noise Distortion, Impulse Response.

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## **Detecting and correcting grammatical mistakes due to subject-verb inconformity and conflicts in tense aspects in Tamil sentences**

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A grammar checker checks each sentence in a text whether it conforms to the grammar, and in case it finds conflicts in the conformity, it would suggest alternatives to the word(s) that causes the conflict. An approach to detecting and correcting grammatical mistakes due to subject and finite-verb disagreement with regard to person, number and/or gender and due to disagreement in tense aspects in Tamil sentences is proposed in this paper. Hierarchical POS tags of words are used to detect the grammatical mistakes and two sets of Tamil grammar rules are used to generate suggestions. First set of Tamil grammar rules is used to generate suggestions to correct mistakes due to subject and finite-verb disagreement, and the other one is used to generate suggestions for tense aspect disagreement. These grammar rules have been defined in the form of Python conditional statements based on standard Tamil grammar. Alternative suggestions for both subject and finite-verb are given for personal pronouns of third person and alternative suggestion is given for finite-verb for all types of subjects, not just for pronouns. Moreover, a list of tense-aspects words mapped to tenses is prepared and used for giving suggestions in case of tense aspect disagreement. Test results show that the proposed grammatical mistake detection and correction system performs well. For 100 testing sentences with all kinds of grammatical mistakes mentioned above, it gives 136 suggestions, a Scholar in Tamil language approved 132 suggestions as most suited and the remaining 4 are as acceptable.

**Keywords:** Tamil, Grammar Checker, Subject and Finite-verb, Tense, Error Correction

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## **A controlling and monitoring tool for fertilizer usage for paddy cultivation: “PADDYPAL”**

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Paddy cultivation depends on fertilizers to obtain high yield. Thus, the demand for fertilizers has been increased. It is required to choose suitable fertilizers in correct quantities to get maximum yield while minimizing harmful effects. Sri Lankan farmers face difficulties when selecting proper fertilizers and quantities based on environmental conditions of paddy field (soil and climate) and paddy variety. Agricultural Instructors (AIs) are responsible to give advices to determine correct fertilizers. But, AIs face many difficulties when analyzing individual farms with various conditions (pH value, soil moisture, nitrogen content of soil). It is also difficult to visit each farm because each AI is assigned to many farms. Some studies attempt to find a solution to determine soil nitrogen level using leaf color code. However, it is not completely correct to determine required fertilizer because leaf color depends not on only soil nitrogen level but also on other factors such as insect and disease attacks. As a solution, we have developed mobile-based and web-based applications to help farmers to make decisions by themselves. Mobile application provides required fertilizers in correct quantities by considering both leaf color code and environmental factors. Through this application farmers are able to view fertilization schedule in terms of tentative dates of applying fertilizers (Urea, TSP, MOP) and relevant amounts with respect to planting dates. Further, it displays the accumulative composition of Urea, TSP, MOP used for the cultivation and total cost for fertilizers. It also facilitates real time communication. Web application is mainly used for decision marking by AIs and other agriculture authorities. By analyzing real time data collected through mobile application, decision makers can take important decisions about paddy production, fertilizer usage, cost for fertilizers based on districts, provinces, or island wide. Both applications were evaluated using questionnaires. More than 80% of participants satisfied with core functionalities of both applications. The work reported here is an attempt towards developing a complete fertilization schedule for paddy cultivation in Sri Lanka.

**Keywords:** mobile-based applications, web-based applications, management dashboard, applying fertilizer

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## **A preliminary study on hearing problems of workers due to exposure of high occupational noise for a long period**

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Exposure to intense noise may cause adverse health effects, in particular, problems in hearing. This paper presents some hearing problems of workers due to high occupational noise exposure for a long period. A sample of 73 workers who exposed to levels of noise over 85 dB(A) daily was identified, audio-metrically tested and audiograms were investigated. A questionnaire was used to gather relevant background information directly from workers. B&K Type-2250 handheld analyzer was used to measure noise levels at workplace. “Amplaid A321” audiometer was used to obtain audiograms. Out of the selected sample, 74% of workers had exposed to 85 dB(A) or more of  $L_{Aeq,8h}$  occupational noise over 40 hours per week for a period of 5 years or more. Depending on the degree of Hearing Loss (HL), the sample was classified into normal hearing (0-25 dB(A)) : 10.5%, mild HL (26-40 dB(A)) : 67.0%, moderate HL (41-55 dB(A)) : 21.75%, moderate-to-severe HL (56-70 dB(A)) : 0.75% and none falls in to Severe HL or Profound HL categories. These categories were mapped with the responses of the questionnaire. Based on the HL and the configuration of audiograms of Air Conduction (AC) and Bone Conduction (BC) measurements, 89.5% of the sample with a HL was classified as, Conductive Hearing Loss (CHL 2.25%), Sensorineural Hearing Loss (SNHL 85.75%) and Mixed Hearing Loss (MHL 1.5%). Some of the SNHL sample was identified as Meniere’s disease 19%, Acoustic Trauma 12% and Noise Induced Hearing Loss (NIHL) 6%. NIHL were recorded among the workers who were highly exposed to noise in the frequency range 3000-6000 Hz. A significant fraction (89.5%) of the sample studied was suffering from mild, moderate or moderate-severe HL. The majority of them (85.75%) were identified as suffering from Sensorineural Hearing Loss.

**Keywords:** Noise exposure, Hearing loss, Audiometric hearing test, Hearing threshold shift

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## **Comparison of anatomical characters of flower colour morphs of *Calotropis gigantea* (L) found in Sri Lanka**

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The flowering shrub *Calotropis gigantea* (L.) R. Br. (Family Apocynaceae) which is commonly known as giant milk weed or crown flower is a very common plant in tropical, sub-tropical and Arabic countries. It is a medicinally important plant and different parts (leaf, bark, root, flower etc.) of the plant are used in folk medicines. On the basis of floral colour of *C. gigantea*, purple and white flowered forms are found in Sri Lanka. Purple form is abundant and white form is rare. Correct identification of these two forms is important for taxonomic and conservation purposes. However, in the absence of flowers, the differentiation of one form from the other is difficult. Therefore, anatomical study of leaf, stem and root of both forms was carried out using Light Microscopy (LM) along with the standard staining techniques to determine whether there are characteristics that can be used to identify the two forms. In both forms, amphistomatic irregularly distributed cyclocytic stomata were observed. Thin-walled, unbranched and unicellular trichomes were found in leaves and stems. In lamina, compact parenchyma, with no differentiation to palisade and spongy were observed. Bi-collateral vascular bundle with several parallel rows of xylem elements were observed in leaves and petioles. Simple or branched (‘Y’ or an ‘H’ shaped) laticifers were observed throughout the vegetative parts. Cubic shaped crystals and druses were observed in root of both forms. All anatomical features observed were monomorphic for both forms. These results clearly point out the necessity of studying more precise characters such as molecular markers for the identification of these two forms.

**Keywords:** *Calotropis gigantea*, light microscopy, taxonomy, monomorphic characters

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## Potential of new oyster mushroom strain for Sri Lanka

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*Pleurotus ostreatus* is the most preferred cultivated mushroom species in Sri Lanka. The cultivated strains in Sri Lanka still record low yields irrespective of the considerable research work done so far. Therefore, new mushroom varieties and strains that can perform well in the country are required. The aim of this study was to evaluate the adaptability of new *Pleurotus ostreatus* strain from china for cultivating under local growing conditions. The experiment was carried out at Agriculture Research Station, Telijjawila from August 2017 to May 2018 according to the recommended cultivation practices. Spawns of commonly grown strain and new strain (Fujian Agriculture and Forestry University, China) were prepared and introduced separately in to polypropylene bags filled with sterilized compost media. The experiment was laid in Completely Randomized Design inside the mushroom shed and the above 2 treatments were replicated 25 times. The spawn run rate, morphological characters, biological efficiency, and the Asymmetry index was compared. Results revealed that the biological efficiency (92%), spawn run rate and the average yield of 3 flushes 300 g is significantly higher in the new mushroom strain at  $P > 0.05$ . Time taken for primordial initiation of Chinese strain was observed to be higher when ambient temperature was high. As the new strain has more consumer preferred characters like morphological attractiveness (asymmetry index closer to 1), deliciousness and good texture, it is found to be a potential oyster mushroom strain which could be introduced to Sri Lanka to strengthen cultivated mushroom sector.

**Keywords:** Edible mushrooms, Oyster mushroom

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## **Isolation and identification of acetic acid bacteria from toddy to produce vinegar without using a fermentor**

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The aim of this study was to produce vinegar without using a high cost submerged fermentor which is used in mass scale industries, by isolating and identifying Acetic Acid Bacterial (AAB) species from toddy that yield a high acetic acid concentration to produce vinegar. In the experiment, from coconut toddy samples AAB were isolated using Carr's Ethanol medium. From the preliminary screening, 06 Gram negative bacterial isolates produced yellow colorization around the colonies that indicated the acetic acid production. Motility and endospore staining also were carried out. Furthermore, biochemical characterization of the 06 bacterial isolates resulted *Acetobacter aceti*, *Acetobacter xylinus*, *Gluconobacter hansenii* and *Gluconobacter liquefaciens*. Two isolates were identified as *A. aceti* strains. Isolates were tested for acetic acid productivity, ethanol tolerance, temperature tolerance and acetic acid tolerance. Isolate 05 (*Acetobacter aceti*) was the most potent strain. 5ml of ethanol-yeast extract medium (ethanol 5%) fermented by isolate 05 was titrated against NaOH in 2 day intervals resulted an acetic acid concentration starting from 0.72% and increased up to 5.62% within 14 days of shaking incubation. It was able to grow at temperatures of 30°C, 37°C, 40°C, was able to tolerate ethanol concentrations of 4-10% and remained viable at acetic acid concentrations of 2-4%. This organism was able to produce vinegar of 5.62% acetic acid concentration under low cost conditions without the fermentor which can be modified in to a mass scale vinegar producer.

**Keywords:** Acetic Acid Bacteria, toddy, *Acetobacter*, fermentor, vinegar

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## **Recovery potential and nutrient uptake behavior of Chilli plants (*Capsicum annum* L.) exposed to soil moisture stress: indication for water and fertilizer management**

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Soil moisture deficit has numerous impacts on crop production. Therefore, this study was aimed at investigating the recovery potential of Chilli plants (*Capsicum annum* L.) var. MI2 exposed to soil moisture stress as 25% water holding capacity (WHC), 50% WHC and 100% WHC (control) with stress cycles as 2, 7, 14 and 21 days for each treatment except the control. Eighteen plants in each treatment were arranged in a completely randomized design as a pot experiment under green house condition. Level of survival and growth parameters were assessed. Nutrient uptake behavior under the soil moisture stress was studied under 50% WHC by using Lithium as a non-radioactive tracer. About 40% plants survived under 2-d cycle and the rest died in 25% WHC. More than 50% of the plants survived in 2-d and 7-d cycles in 50% WHC. No significant difference in growth performances were found between the plants grown in 50% WHC under 2-d cycle and the control. Flowering was delayed and the number of flowers were significantly low in the stress treatments except in 2-d and 7-d cycles in 50% WHC compared to the control. Lithium uptake was reduced by 13.5% and 25.5% in 2-d and 7-d cycles in 50% WHC respectively compared to the control. Results showed that chilli plants in 50% WHC with 7-d stress exposure were able to survive and were partially recovered while the plants in 2-d stress in 50% WHC were totally recovered. Also, high amount of fertilizer application under stress condition does not work out to a satisfactory level. Therefore, water and fertilizer application should technically be managed in the presence of soil moisture stress.

**Keywords:** Soil moisture stress, Lithium, plant growth, survivability

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## Effect of neem-priming on seed germination and seedlings vigour of four traditional rice varieties of Sri Lanka

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Most of the Sri Lankan traditional rice varieties have low seed germinability. Seed quality can enhance using seed-priming. Traditional rice varieties; Kaluheenati, Kuruluthuda, Maawee and Madathawalu were used. Distilled water and three (100, 50 and 25%) concentrations of commercially available neem seed extract was used for priming for 24, 48, and 72 hours. Primed seeds were dried at ambient laboratory conditions for 24-hours. Then, seeds were pre-soaked in water for 0, 24, 48, and 72 hours. Germination and vigour of primed and unprimed (control) seeds were tested using paper-towel method and seedling emergence, using four replicates of 100 seeds. Arcsine transformed data were analyzed with one-way ANOVA. Microbial growth from unprimed and neem-primed (NP) seeds on agar plates was determined. Germination percentages of unprimed Kaluheenati, Kuruluthuda, Maawee and Madathawalu seeds (*i.e.* 62, 32, 24, and 20, respectively), were increased after 50% NP for 24+ 24 hours pre-soaking(83%), 25% NP for 72+ 24 hours pre-soaking(64%), 25% NP for 48+ 48 hours pre-soaking(49%) and 100% NP for 72+ 48 hours pre-soaking(55%), respectively. Similarly, seedling emergence of the unprimed seeds of the same four varieties (65, 10, 12 and 40%, respectively) was increased with the same treatments by 83%, 25%, 30% and 53%, respectively. *Aspergillus* spp., *Rhizopus* spp. and several gram-negative and positive, catalase-positive bacteria cocci were isolated from seeds of study the four varieties studied. NP has enhanced the seed quality of the four rice varieties studied. Observed reduction of microbial contamination of seeds after NP could be the reason for observed improvement of seed quality.

**Keywords:** Antibacterial activity, antifungal activity, germination, neem priming and vigour

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## **Characterization of *Pectobacterium carotovorum* isolated from diseased carrots and study on their pathogenicity on selected vegetable crops**

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Bacterial soft rot, caused by *Pectobacterium carotovorum* is a disease responsible for severe post-harvest losses of carrots in Sri Lanka. The present study aimed to isolate *P. carotovorum* strains from diseased carrot samples from different carrot fields and to determine their pathogenicity on selected vegetable crops. Five bacterial strains, namely CSR1, CSR2, CSR3, CSR4 and CSR5 were isolated from diseased carrots and their identity was confirmed using standard biochemical characteristics of *P. carotovorum*. All isolates were positive for catalase test, citrate test and Voges Proskauer test. Each of the isolates showed a luxuriant growth on McConkey agar and they were negative for oxidase, indole and methyl red tests. Pathogenicity of each of the isolates was evaluated by inoculating them on healthy carrot discs. Furthermore, healthy samples of four other vegetables, namely radish, cabbage, potato and pumpkin were inoculated with the isolated *P. carotovorum* strains to study the development of rotting symptoms at 25°C within 48 hours. CSR1 was able to macerate radish, cabbage and pumpkin. CSR2 caused rotting symptoms only in radish. Cabbage and radish were rotten by CSR3 while potato and cabbage did not show any rotting symptom when inoculated with CSR3. The strain CSR4 was able to macerate all four vegetables tested. Potato was the only sample that was macerated by CSR5.

**Keywords:** Soft rot, post-harvest diseases, pathogenicity

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## Study on nutritional and antioxidant properties of selected Sri Lankan traditional sweetmeats

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Sweetmeats are an essential entity of Sri Lankan traditional food culture; however, they have not been fully investigated. This study aimed to investigate the macro-nutrients and antioxidant properties of seventeen traditional sweetmeats (*Hendi kewum*, *Kollu kewum*, *Naran kewum*, *Athirasa*, *Mung kewum*, *Aasmi*, *Kokis*, *Unduwalalu*, *Welithalapa*, *Madu welithalapa*, *Bedihaal piti aggala*, *Dodol*, *Aluwa*, *Thala guli*, *Kurahan helapa*, *Gotu pittu* and *Kiri roti*) popular in Central province of Sri Lanka. Major nutrients were analyzed using standard analytical methods and 80% methanol extracts were tested for antioxidant activities (AA) by Ferric Reducing Antioxidant Potential (FRAP), ABTS scavenging activity and DPPH radical scavenging assays in triplicates. The results indicated that all deep fried sweetmeats have higher fat contents ranged from 2.3±0.18% (*Aasmi*) to 16.1±0.41% (*Naran kewum*). *Unduwalalu* (8.7±0.14%) and *Hendi kawum* (64.0±0.25%) showed the significantly ( $p<0.05$ ) highest protein and carbohydrate contents respectively. The lowest fat and carbohydrates contents was shown in *Badihaal aggala* (2.3±0.18%) and *Kokis* (40.9±0.28%) respectively. All the sweetmeats were energy dense (248-406 kcal/100g) while deep fried *Hendi kewum* had the significantly highest energy ( $p<0.05$ ). Among the sweetmeats examined for AA, *Naran Kewum* showed the significantly highest TEAC (1595.7±0.03 µg/mL TE) by FRAP assay ( $p<0.05$ ). *Helapa* showed the highest radical scavenging activity for DPPH (564.8±0.02µg/mL TE) and ABTS (553.2±0.01 µg/mL TE) assays. These AA may be due to the stable polyphenolic compounds at high temperatures and newly formulated molecules by maillardreaction. The findings of this study provides general consumer about the basic nutritional and functional values of traditional sweetmeats of Sri Lanka.

**Keywords:** Traditional sweetmeats, Sri Lanka, macronutrients, antioxidant activity, energy

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## **Influence of iron toxicity on root characteristics of selected *Oryza sativa* L. varieties under field conditions**

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Iron toxicity is one of the most severe abiotic limitations for paddy cultivation in low-country wet zone (LCWZ) of Sri Lanka, because of its negative impact on rice yield. The present study examined root characteristics of two rice varieties, i.e. Fe tolerant Bw 267-3 and Fe susceptible Bw 272-6b grown in naturally iron-rich soils at Regional Rice Research and Development Center (RRRDC), Bombuwela, in 2017/2018 'Maha' season. Plants were grown in field in a Complete Randomized Block Design, with three replicates. Selected morphological characters and physiological parameters of roots were examined at two growth stages; the maximum tillering and flowering. The results showed that, soil Fe content and soil pH in selected rice field at time of planting was  $605.74 \pm 160.51$  mg/kg and  $4.84 \pm 0.20$  respectively, which could induce toxic effects in rice plants. The root length, root volume, number of adventitious roots and root dry matter in Bw267-3 were significantly higher than in Bw272-6b at both growth stages, confirming their previously demonstrated tolerant and susceptible traits (one-way ANOVA:  $F=134.97$ ,  $p<0.05$ ). The total iron content in root plaque was greater in susceptible Bw272-6b than in tolerant Bw267-3 at both growth stages, while the iron content inside the root showed a reverse pattern. As toxicity symptoms are linked to the ability of iron to pass into roots and thereby to other parts of paddy plant, the disparity in root growth and iron accumulation demonstrated between the two varieties in the present study would most likely be linked to their inherent traits of iron toxicity tolerance.

**Keywords:** Field screening, Iron toxicity, LCWZ Sri Lanka, rice-root characteristics

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## ***In-vitro* screening of ethyl methanesulfonate (EMS) treated shoot tips of banana for fusarium wilt using fungal co-cultivation**

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Induced mutation in conjunction with *in-vitro* culture increases the effectiveness of mutation induction through handling large populations. It facilitates *in-vitro* screening conditions against targeted disease and rapid multiplication of selected variants. Koilkuttu (silk banana (AAB) which demands high price in the local market is highly susceptible to fusarium wilt caused by soil borne pathogen *Fusarium oxysporum* f.sp. *cubense* (*Foc*). In the present study, *in-vitro* proliferated shoot tips of Kolikuttu banana variety 'Agra' were treated with ethyl methanesulfonate (EMS) aiming to develop plants resistance/less susceptible to fusarium wilt. The EMS treated shoot tips were multiplied for subsequent 3 subculture cycles and rooted *in-vitro*. A total of 320 numbers of plantlets cultured in ½ strength Murashige and Skoog (1962) medium were used for the co-cultivation technique. Each culture with a rooted plantlet was inoculated with a piece of filter paper soaked in a 1x10<sup>6</sup> spores/ml suspension of the pathogen and incubated at 25±2<sup>0</sup>C temperature, 12/12 day/night photoperiod with 50µmolm<sup>-2</sup>s<sup>-1</sup> light intensity for 4 weeks. The survived plantlets (2%) were potted in sterilized coir dust:sand (3:1 ratio) medium and were hardened inside a propagator. After 3 weeks, plantlets were shifted to a polytunnel. The remaining plants were then subjected to further screening on a pathogen inoculated soil mixture. From the *in-vitro* survived plants, 5 nos. of plants were infected with *Foc* at later screening stages. Randomly Amplified Polymorphic DNA (RAPD) was performed for the two plants survived along with a positive control. According to the dendrogram the similarity of these 2 plants with the control (untreated Agra) was above 66.67%. Results of the present study confirmed the necessity of further screening of survived plants *in-vitro*.

**Keywords:** banana, *Fusarium oxysporum*, *in-vitro* screening, mutation and pathogen

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## **Nutritional quality of *Oryza sativa* L var. Bg 360 and At 362, and *Eleusine coracana* var. Ravana**

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The main source of carbohydrates of Sri Lankans are cereals. *Oryza sativa* L. (Rice) is the staple food of Sri Lankans while *Eleusine coracana* (Finger Millet) is popular among rural and health-conscious communities. The objective of this study is to estimate the nutrient content of selected commonly consumed cereal varieties. Two rice varieties, Bg 360 and At 362 and a finger millet variety 'Ravana' were evaluated for moisture, ash, crude fibre, fat and crude protein contents. Antioxidant activity of the cereals were analyzed by DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity. The highest crude fibre ( $5.35 \pm 0.90\%$ ) and ash ( $5.44 \pm 1.20\%$ ) contents were shown in At 362 rice variety. The highest moisture ( $14.61 \pm 0.25\%$ ), crude protein ( $2.34 \pm 0.25\%$ ) contents and antioxidant activity ( $359.38 \mu\text{g/mL}$ ) were recorded in Finger millet variety. The results reveal that red colored rice variety At 362 and Finger Millet variety 'Ravana' are rich in nutrients compared with white colored rice variety Bg 360. Rice varieties rich with bran layer and finger millet varieties provide more nutrients and health benefits to consumers.

**Keywords:** Antioxidant activity, cereals, proximate composition

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## **Farmers' knowledge on pesticide usage in vegetable cultivation in Badulla district, Sri Lanka**

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Pesticide spraying has become a common practice in commercial vegetable cultivation with the adoption of new technologies. In spite the benefits, pesticides pose potential hazards to human health and to the ecosystem when inappropriately handled. Sri Lankan farmers often use pesticides based on their experience and misuse and overuse often lead to health and environmental threats. Hence this study was conducted to assess the farmer's knowledge and practices on safe use of pesticides among vegetable farmers in Badulla district. Vegetable farmers (n=100) were selected by using proportionate sampling, and primary data were collected from them through personal interviews. Results revealed that 92% of farmers were engaged in full time vegetable cultivation. Almost all the farmers depended on the chemical pesticide for the management of pests. About 93% of farmers used Marshal 20 SC (Carbosulfan) which is a broad spectrum carbamate pesticide that acts by inhibiting the activity of acetylcholineesterase to control insect pests. 68% of farmers used Cabrio Top (Pyraclostrobin 5%+ Metiram 55% WG), the broadspectrum fungicide. All farmers use at least one precautionary measure during the pesticide application. Only 40% of farmers used gloves during pesticide application and 79% of farmers used caps. About 90% of the farmers read the label on the pesticide bottle before using it. 96% of the farmers washed the clothes that they were wearing during pesticide application separately. Almost all farmers avoid splashing, spilling, leakage during spraying. Results of the chi-square analysis revealed that there was a highly significant association observed between the education level of the farmer and reading the label before opening the pesticide container ( $\chi^2 = 11.4$ ,  $p < 0.01$ ). It is recommended to conduct awareness programs to change farmers' attitudes towards judicious and safe use of pesticides.

**Keywords:** Agricultural safety, health hazards, pesticide spraying

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## Effectiveness of rooting media on the propagation of miniature rose (*Rosa chinensis minima*) by stem cuttings

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*Rosa chinensis minima*, a small bush like ornamental plant which belongs to the family Rosaceae is popular in home gardening in Sri Lanka. Therefore, the demand for this plant is increasing. Usually, farmers in Sri Lanka propagate this plant by stem cuttings using normal soil medium. However, the effectiveness of rooting is poor compared to the other species propagated by stem cuttings. Therefore, effectiveness of rooting of *Rosa chinensis minima* by stem cuttings in different rooting media was investigated. For this, different rooting media were combined with stem cuttings at varying maturity stages. Three types of rooting media namely, red podzolic soil, sand and sand: coir (1:1 ratio) were used. Highly mature, moderately mature and young stems cuttings of *Rosa chinensis minima* were used. A pot experiment was carried out according to the completely randomized block design. There were nine treatments with two replicates for each treatment. Fifteen of similar cuttings were planted in each pot. Parameters observed were the percentage survival of cuttings, root length, root fresh weight, root dry weight and root volume. Measurements were taken after 20, 30 and 40 days of planting. The data were statistically analyzed. The result revealed a significant effect of stem type on survival percentage (probability = 0.00), root length (probability= 0.00), root dry weight (probability = 0.00), and root fresh weight (probability=0.00) of *Rosa chinensis minima* cuttings. There were significant differences in survival percentage, root length, root dry weight and root fresh weight (probability = 0.0000 for each) among the different media used. The result indicated that hardwood is the best stem age for the rooting and the red podzolic soil is the best medium for the rooting of highly mature cuttings of *Rosa chinensis minima* among the media used in the experiment. For moderately mature cuttings the red podzolic soil and coir-sand media were best.

**Keywords:** miniature rose, *Rosa chinensis minima*, rooting media, stem cuttings

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## **Assessment of selected quality parameters of top soil and surface water in the vicinity of the laboratory wastewater pits of the Department of Chemistry, University of Ruhuna, Matara**

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This study aimed to investigate the environmental impact of discharging laboratory wastewater containing chemical residues directly into the soaking pits by the Department of Chemistry, University of Ruhuna. The department generates a considerable amount of chemically contaminated wastewater from its laboratories and directly discharges into underground pits without any pre-treatment. Therefore, the chemicals used in these laboratories pose a significant contamination risk to water resources and soil when they escape into the environment. Two sets of soil samples were collected along two lines downward centring underground wastewater pits. In addition, a set of sample was collected following the same grid pattern but aside the underground pits as reference. Soil samples were analyzed for pH, conductivity, soil organic matter, phosphorous, Pb and Fe following standard chemical and analytical methods. A set of surface water samples was collected from the stream near the department and was analysed for pH, conductivity, DO, BOD, COD, dissolved organic matter, Pb and Fe. It was revealed that all the soil quality parameters of two sample sets are comparable with that of reference samples despite insignificant deviations from place to place. The quality parameters of surface water samples indicated no significant contamination, according to our data. The overall study reveals that there is no significant impact to the topsoil and surface water of the vicinity of the Department of Chemistry, University Ruhuna. Groundwater analysis should be carried out in order to report the complete environmental impact of this wastewater disposal.

**Keywords:** Chemically contaminated wastewater, disposal, topsoil, surface water

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## **Starch characteristics of selected *Ipomea batata* (sweet potatoes) cultivar in Sri Lanka**

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This study aimed to make available data on some starch characteristics of selected sweet potato (SP) cultivars available in Sri Lanka and to see whether there is a correlation with the high glycaemic indices (>70) of these tubers. Sweet potato varieties Ama, Wariyapola Red, Wariyapola White and Dhawala were selected for the study. Both raw and boiled sweet potato flours were used for the determination of size distribution of carbohydrate by using Sepharose™ CL-6 B column with KOH and carbohydrate contents were quantified by phenol-sulphuric assay. Bed volume was determined using glucose (5mg/ mL). Amylose content of flour was determined calorimetrically. High molecular weight carbohydrate (HMWC;  $K_{av} < 0.2$ ) contents of studied SP ranged between 7-11% in raw and 6-10% in boiled flour. Intermediate molecular weight carbohydrate (IMWC) ( $0.2 < K_{av} < 0.8$ ) contents of both raw and boiled sweet potato varieties were high and ranged between 86-89% and 89-94%. The low molecular weight carbohydrate contents (LMWC;  $K_{av} > 0.8$ ) constituted <6% of carbohydrates in both raw and boiled, indicating low free sugar content. Amylose contents of the raw and cooked samples were less than 30 indicating high amylopectin contents in SP. The high amylopectin with intermediate molecular weight may have contributed to the high glycemic indices observed in the sweet potato varieties.

**Keywords:** Sweet potatoes, starch, gel filtration, amylase

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## **Assessment of groundwater quality in the municipal area of Jaffna peninsula**

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The Jaffna peninsula mainly depends on groundwater for drinking and other purposes due to lack of fresh water resources. The objective of this study was to evaluate the groundwater quality for its suitability for drinking purpose. Water quality parameters such as total hardness,  $K^+$ ,  $NO_3^-$  and  $SO_4^{2-}$  contents were determined for 32 wells, randomly selected in the Jaffna municipal area, during December 2017 to March 2018. The water quality parameters were analyzed based on Sri Lankan standards for potable water-SLS 614:2013. The sulfate, fluoride and nitrate contents were measured by using COD-Multiparameter-photometer. pH of the water samples was measured by a portable pH meter. Flame photometer was used to measure the potassium level. Measured nitrate content varied from 15-170.5 ppm, and this is about twelve-fold increase compared to previous values of 30 years ago. Other water quality parameters pH, hardness, TDS, sulfate and potassium varied as 6.5-8.5, 168-1232, 189-5440, 5-700 and 1.2-144 ppm, respectively. It is evident from the results that 94% of wells has higher hardness and TDS compared to Sri Lankan standard. 28% of wells and 31% of wells showed higher nitrate and sulfate contents, respectively. Higher potassium content was found in 85% of wells. Because of the inadequate sewage disposal facilities, highly polluted areas near the wells and most of the wells are situated close to soakage pits of the toilets, the water quality is not suitable for drinking purpose in Jaffna municipal area. The excessive ions from the water should be removed before the water is consumed for drinking.

**Keywords:** Nitrate, pH, Jaffna municipal area, water quality parameters

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## **Survey on distribution of Milkweed, *Calotropis gigantea* L. (Apocynaceae) in Sri Lanka and the associated insect diversity**

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*Calotropis gigantea* is a drought-resistant and salt-tolerant small shrub native to Sri Lanka. It is a poisonous plant often used in herbal medicine for asthma, leprosy, nausea, vomiting and fever. The present study was carried out to find out the distribution of *Calotropis gigantea* and to identify the insect fauna associated with the plant. Surveys were conducted from December 2014 to June 2015 in 120 sites covering all provinces of Sri Lanka, and the incidence of *C. gigantea* and the insect fauna on them were recorded. *Calotropis gigantea* was recorded in all provinces of Sri Lanka except the Central Province. The plant widely spreads along coastal regions of the island, but its incidence was low in the Western as well as Sabaragamuwa provinces. A total of 28 morphospecies of phytophagous insects and three species of pollinators across nine families were documented in the present study. Occasional insect visitors to the plant were recorded with a high diversity and they belonged to five orders. Among the phytophagous insects, *Dacus persicus* and *Paramecops farinosus* are highly damaging to *Calotropis* fruits while *Sphaeroderma* sp. was more common in the area. Carpenter bees were the most abundant insect pollinator of the plant. Findings of the present study provide basic information on distribution of *Calotropis gigantea* and its associated insect fauna in Sri Lanka.

**Keywords:** *Calotropis gigantea*, phytophagous insects, pollinators

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## **Knowledge on post exposure treatment for Rabies among general practitioners in the Southern Province, Sri Lanka**

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Rabies is a zoonotic disease that is essentially fatal. Post-exposure treatment (PET) is the immediate treatment of a bite victim after rabies exposure. Proper knowledge on PET among doctors is crucial in preventing rabies deaths. Objective of this study was to describe knowledge on post exposure treatment for Rabies among General Practitioners in Southern Province. A descriptive cross sectional study was performed, involving all General Practitioners (GP's) who serve in Southern Province. Sampling frame was prepared by obtaining all the names of GP's in Southern Province by applying several sources like GP's association data base and Health Ministry data base. Simple random sampling was done to choose required number of participants out of the study population. A structured self-administered questionnaire was used. It was pretested by giving to 5 GP's in Colombo District. Variables were based on guidelines on PET issued by Ministry of Health. There were closed ended questions arranged under 4 sub headings. An invitation letter was send with questionnaire and then information was collected from returning ones that arrived via post. A 'composite score' was developed by assigning marks to correct answers (maximum 20). Equal weight was given to all questionnaire items. Out of the 465 who were invited, only 336 responded (non-response 27.7%). Mean age was 33.2 (SD 6.2). Majority were females (n= 348, 75.0%) and doing part time GP practice (n= 407, 87.5%). Knowledge of giving oral antibiotic and avoidance of suturing following bite were satisfactory (63.5% and 87.5% were correctly noted). Majority clearly defined period of last vaccine in determining the immunity status. Identification of criteria for major exposure was also good. Mean score was 14.4 and could be considered as satisfactory. Those who were having post graduate qualifications showed a better knowledge than others (p = 0.02, t 3.23). GP's in Southern Province were having a satisfactory knowledge. Those who had PG qualifications showed a better knowledge than others.

**Keywords:** General Practitioners, post exposure treatment, rabies

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## **Antioxidant properties of *Sargassum* sp. found in southern coastal region in Sri Lanka and their use in extending shelf-life of foods**

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Since phenolic compounds exhibit radical scavenging properties and there is a co-relation between the phenolic content and the anti-oxidant properties, the present study will identify the presence of phenolic compounds in four varieties of *Sargassum* sp. available in southern coast of Sri Lanka, and the possibilities of their food applications. Specimens were collected from Hikkaduwa, and the cleaned samples were dried and grounded with cryogenic grinding to form powder. Phenolic content analysis was conducted by Folin-Ciocalteu method by using the 100% methanol extraction followed by addition of Sodium Carbonate and incubation. Results were obtained by measuring the absorbance at 765nm as a concentration of Gallic Acid equivalent and four varieties *Sargassum* sp. portrayed a phenolic content of  $6.2\% \pm 0.021$ ,  $3.7\% \pm 0.021$ ,  $3.4\% \pm 0.002$ ,  $2.7\% \pm 0.008$  from the plants' dry weight respectively (With 1265mg/l GAE, 720mg/l GAE, 661mg/l GAE, 523mg/l GAE respectively). Upon identifying the phenolic content of the seaweed, further analysis was conducted to assess the anti-oxidant activity of the species. Methanol extractions of seaweeds were assessed for DPPH free radical scavenging activity. All the four species exhibited a free radical scavenging activity with species 01 demonstrating the highest activity of  $21.7\% \pm 0.1$  at the DPPH concentration of 100  $\mu\text{g/ml}$ , against the control sample. At the next stage, a cookie was formulated by inclusion of the seaweed powder at 5% of each of the *Sargassum* sp. The free radical scavenging activity of the seaweed was measured by evaluating the shelf life of the cookie, with sensory parameters against the control. It was found that the cookie with the powder of *Sargassum* sp 01 had the highest extended shelf life from 3 months totaling up to a shelf life of 6 months, where the control had only a 3-month shelf life.

**Keywords:** *Sargassum* sp., phenolic content, shelf life, free radical, seaweeds

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## **Antimicrobial efficacy of selected commercially available mouthwashes**

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Mouthwashes are often used by people as they are prescribed by the dentistry, with the intention of prevention and treatment of several oral conditions. Many of commercially available mouthwashes claim to have antimicrobial properties. This *in vitro* study mainly aims to determine the antimicrobial efficacy of commercially available mouthwashes. Four commercially available mouthwashes including an Ayurvedic mouthwash were included in the study. The antimicrobial efficacies of selected mouthwashes were tested against five selected microorganisms namely, *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Streptococcus pyogenes* and *Candida albicans* using agar well diffusion method and disc diffusion method. The experiments were replicated thrice. A validation test was done to determine whether there is an antimicrobial effect of the mouthwashes. The results obtained from the Tukey test indicated that, the highest effectiveness was shown by mouthwash 1 against *Candida albicans* in both disc and well diffusion methods (average inhibition zone diameter of 20.67 mm in both cases) The second highest effectiveness was shown by the mouthwash 1 against *Streptococcus pyogenes* and the third highest effectiveness was showed by the mouthwash 1 against *Escherichia coli*. Mouthwash 1 contained chlorohexidine gluconate as the active antimicrobial component. Between the two non-herbal mouthwashes, the least effectiveness was showed by the mouthwash 2 against *Pseudomonas aeruginosa*. It contained chlorohexidine-digluconate as the active ingredient. The Herbal and Ayurvedic mouthwashes didn't show antimicrobial properties.

**Keywords:** Antimicrobial, mouthwash

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## **Establishment of technique for isolation of phagocytes from peripheral blood of elephants (*Elephas maximus*)**

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In elephants, both neutrophils (heterophils) and monocytes which are phagocytic white blood cells serve as the first line of defence. Measuring the phagocytic efficiency of the leukocytes could be an important parameter to evaluate the innate immunity in any animal. Such studies in elephants however, require laboratory techniques for isolating functionally active phagocytes from blood. If established, such laboratory test could detect possibly immune-suppressed elephants for treatment and special care. Eight venous blood samples (5 ml each) from 4 captive male elephants were used. After obtaining total blood counts and the differential counts, samples were centrifuged for 2000 g for 10 min. Plasma were separated, buffy coat and the 1<sup>st</sup> quarter of the red cell column was pipetted out, and was subjected to hypotonic lysis of red blood cells and isotonicity was restored with 2.7% phosphate buffered saline (PBS). After centrifugation, remaining cell pellet was washed 3 times with 0.8% PBS and subjected to Nigrosine (0.1%) dye exclusion test for viable counts. This method resulted in leucocyte isolations with negligible contamination of RBC with  $99.3 \pm 0.2$  % viability.  $39.8 \pm 4.7\%$  of the total leukocytes could be harvested by this method and out of that  $65.5 \pm 11.3\%$  were phagocytes. Average 40% of heterophils and 55.5% monocytes showed positive phagocytosis when two of these isolates were incubated with opsonized bacteria (*E. coli* ATCC 25922). This procedure once improved, quantified and standardized, will provide a suitable technique to isolate phagocytes from elephant blood and a method to quantify their phagocytic ability.

**Keywords:** Asian elephant, leukocyte isolation, phagocytosis

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## **Development of suitable method for the concentration of *Citrus madurensis* and *Spondias dulcis* juice**

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Fruits are an excellent source of Vitamin C. *Citrus madurensis* (NasNaaran) and *Spondias dulcis* (Ambarella) are two tropical trees that bear fruits with high levels of Vitamin C, flavor and aroma compounds. Both fruits are currently under-utilized and therefore, this study was carried out to identify suitable method to concentrate their fruit juices while retaining the original qualities of the juices. The fruits were obtained from Maharagama in the Western province and juices were extracted by peeling and blending. The juices were concentrated by using Progressive Freeze Concentration (PFC), a novel non-thermal liquid food concentration method and evaporative concentration (Rotary Evaporation) method. The vitamin C content in the original juice and the concentrated juices were determined by spectrophotometrically at 521 nm. *C. madurensis* was concentrated up to brix 7.9° from brix 5.4°. *S. dulcis* was concentrated up to brix 9° from 6.9° using PFC and *C. madurensis* juice was concentrated up to brix 10.6° from 7.5°. *S. dulcis* was concentrated up to 10° brix from 7° from evaporative concentration. The initial vitamin C content in NasNaaran and Ambarella were 19.87 and 26.73 ppm respectively. Vitamin C loss for PFC method for *C. madurensis* and *S. dulcis* was 18.94% and 3.47% respectively. Vitamin C loss for evaporative concentration method for *C. madurensis* and *S. dulcis* was 73.67% and 29.24% respectively. Therefore, PFC is a suitable method to concentrate liquid fruit juice compare to conventional evaporative concentration.

**Keywords:** Progressive Freeze Concentration, rotary evaporation, vitamin C, spectrophotometric method

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## **The status of maintaining partograms in labor rooms: A case study from District General Hospital- Kalutara**

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Introduction of partograms to labor rooms has made a significant impact on improving perinatal care in Sri Lanka, because it has helped in detecting risk situations early and allowed medical staff intervening promptly. Assessing the current status of maintaining partograms is of utmost importance in finding deficiencies and recommending ways for improvements. This study was designed to describe the status of maintenance of partograms in General Hospital (GH) in Kalutara. A descriptive cross sectional study was done involving all labor rooms in Kalutara GH over a period of three months in 2017. A data sheet was used to collect information related to maintenance and completeness of partograms. A total of 402 completed deliveries were taken for analysis. Study population had mean age of 30.6 (SD 4.8) years. Majority of mothers were 'primi' (n = 281, 69.9%), 48 (11.9%) had past section while 31 (7.7%) deliveries were breech presentations. Commonest antenatal morbidity was pregnancy induced hypertension (n= 40, 9.6%). Among all deliveries, partograms were started in 198 (49.3%) instances. Among mothers who were taken to labor room during day time (from 6.00 am to 6.00 pm) 56.0% (130 out of 232) were monitored by partograms while the corresponding rate during night time was 40.0% (68 out of 170). Parameters related to the progression of labor (cervical dilatation and descent) were satisfactorily marked as in 180 out of 195 partograms. But only in 42 instances, they were continued till end. Recording of parameters pertaining to maternal wellbeing was poor as only in 92 of partograms an attempt was made. But again only for 41 mothers, it was continued till end of labor. Fetal heart rate was documented in 143 of partograms while only in 76 it was continued till end. It can be concluded that using partograms to record important parameters of labor was not satisfactory in comparing with the standard practice. Even among those partograms, much attention was paid on progression of labor while recording of indicators of maternal wellbeing was poor. This warrants raising awareness among labor room staff on importance of starting and maintaining partograms.

**Keywords:** Partogram, Progression of Labor

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## **Primiparous mothers' perception regarding breastfeeding education at Teaching Hospital Mahamodara, Sri Lanka**

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As a part of standard antenatal care, breast feeding (BF) information, demonstration and professional interventions play vital roles in improving the rates of BF. The aim of this study was to examine the primiparous mothers' perception regarding BF education they had received as theory and demonstrations including professional interventions. Descriptive cross sectional study was conducted participating 242 primiparous, postnatal mothers as a convenience sample. Data collection was done using interviewer-administered questionnaire during the period of February to March 2018. Out of the participants, 41.7% (101) were 28-33 years old, 50.8% (123) were educated up to advanced-level and 59.1% (143) were housewives. Study findings revealed that the participants have gained knowledge related to BF as: Advantages of BF 96% (232), Exclusive BF 91% (220), Demand feeding 88% (212), and Positioning and attachment 74% (179). Findings related to professional support, the mothers experienced as: nurses' and midwives' assistance to initiate BF 92.6% (224), maintain good rapport 88% (212), professional competency 95.4% (231), and interventions done to relieve anxiety and fear on BF problems as 94.2% (228). The study findings of the mothers' perception show that the BF educational programme is successful but needs some modifications for further development.

**Keywords:** Breast feeding education, primiparous, postnatal mothers

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## **Garlic and ginger extracts as feeding deterrents for the giant African snail (*Achatina achatina*): a preliminary study**

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African giant snail (*Achatina achatina*) is known as a serious pest of seedlings and leaf vegetables throughout the world including Sri Lanka. Their nocturnal and hiding behavior make them very difficult to be controlled using conventional pest control methods. Present preliminary study aimed to find out the potential use of the extracts of two spices namely garlic and ginger as feeding deterrents for *A. achatina*. Snails hatched from one egg clutch with body weight ranged from 3.3 to 4.9 g were used in the study. They were divided as the control group, garlic-treated group and ginger-treated group using 21 snails. The snails were daily fed with fresh tree spinach leaves (*Talinum paniculatum*) treated with distilled water (control) and either 2.5% aqueous extracts of garlic or ginger. Leaf area was measured by Planimeter before the treatment and one day after feeding. Body weights of experimental snails were recorded in 72 hrs. intervals from June 2018 to October 2018. The results reveals that the snails do not prefer to feed on leaves treated with aqueous extracts of both garlic and ginger and percentage feeding preference for garlic (66.67%) and Ginger (45.0%) was lower than that of the control (78.72%). At the end of the experiment (66<sup>th</sup> day), mean body weight of snails which fed on garlic treated leaves (3.21 g) was lower compared to the mean body weights of those fed on ginger treated leaves (3.6667 g) and the control (4.6033 g). Findings of the present study indicate the possible use of garlic extract as a feeding deterrent for *A. achatina* and further studies are needed to assess the effects of these extracts at field level.

**Keywords:** *Achatina achatina*, feeding deterrents, garlic extract, ginger extract

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## **A mathematical model for natural resistance against galactosemia**

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Infants with Galactosemia cannot metabolize lactose and galactose, two sugars found in milk. Because in the infant gut, the galactose converted to glucose through a series of enzymatic reactions. In Galactosemia, galactose-1-phosphate uridyl transferase (GALT) is missing or defective. This means too much galactose will build up in blood, resulting in, among other things, liver failure. Galactosemia is a rare genetic disorder relates with the subject, negative eugenics, the use of sterilization to eliminate harmful genetic traits from human society. Often, the reason that lethal recessive traits occur is that normal alleles mutate to defective alleles. There are a number of different alleles that can cause variations of Galactosemia. Mutation rates are difficult to estimate directly. In this paper, we have proposed a dynamical system model and approximated a joint mutation rate for the lethal traits, given the equilibrium genetic makeup of the population. We used the information on the fraction of children born with the genetic trait to determine the equilibrium genetic makeup. By computations, it is clear that mutation rate declines and the risk of Galactosemia decreases. So natural selection can work to decrease the proportion of the harmful genetic traits from human society.

**Keywords:** Galactosemia, galactose, glucose, mutation, equilibrium

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## Stock market prediction using machine learning algorithms

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The study will consider how machine learning models can be used to predict Sri Lankan stock market prices. Artificial intelligence is an emerging trend for most of the things. So why not for stock market prediction. Researchers point out that these models can provide more than 70% accuracy rate. When it comes to Sri Lankan context we need to specify most appropriate data set that we can use with machine learning models. Then feed these data to machine learning models such as artificial neural network (ANN), Support vector machine (SVM) and Decision trees (DT). ANN is one of the main tools used in machine learning, which is a brain-inspired system that intended to replicate the way that humans learn. Since there are several types of ANNs, Multilayer Perceptron (MLP) model is used in this research. Decision tree algorithm can be used as a tool for data mining and trading. It performs a set of recursive actions before it output the result. SVM is a relatively new learning algorithm that can used to calculate price volatility and momentum for individual stocks. This study uses daily open, high, low, close prices, trade volume, share volume, turnover and beta value as input variables for all the models. Prediction results are compared with the actual values. To evaluate the performance of three models three commonly used evaluation criteria are applied in this study. Evaluation criteria consists of root mean square error (RMSE), mean absolute error (MAE), and mean absolute percentage error (MAPE).

**Keywords:** Stock Market, Artificial Neural Network, Support Vector Machine, Decision Trees

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## **Analysis of CI engine performance with waste polypropylene derived fuel blended with diesel**

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Feasibility of using hydrocarbon fuel extracted from pyrolysis of waste polypropylene (PP) as an alternative fuel blended with diesel in a compression ignition (CI) engine was investigated. A semi-batch reactor plant built at the department was used to extract samples of waste polypropylene derived fuel. The extracted liquid fuel was blended with diesel and used in the analysis of engine performance of a CI engine. The blending of waste PP derived fuel with diesel varied from 10% to 70% by volume. The variation of brake power (BP), brake specific fuel consumption (BSFC) and brake thermal efficiency (BTE) at different loading (varies from 0 W to 5000 W by steps of 1000 W) for pure diesel and the blends were investigated. For the blended fuel mixtures, the brake specific fuel consumption was found to vary in the range 0.208 ml/kJ - 0.315 ml/kJ at low load (1000 W) and 0.107 ml/kJ - 0.122 ml/kJ at high load (5000 W). The brake power was observed to vary between 960 W and 920 W at low load and between 4347 W and 3400 W at high load. The calculated brake thermal efficiency varied between 8.87% and 13.02% at low load and between 22.08% and 25.38% at high load. Engine performance of 10/B/PP/D to 50/B/PP/D is almost same or slightly higher than that of diesel. Therefore, it can be concluded that use of 10/B/PP/D to 50/B/PP/D blends in diesel engines may perform similar to use of diesel. However, cleanliness of waste PP derived fuel has to be improved to use this alternative fuel in commercial vehicles.

**Keywords:** Waste polypropylene derived fuel, Diesel engine, Brake power, Brake specific fuel consumption, Brake thermal efficiency

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## **Sound absorption characteristics of two selected fruit plants, *Anacardium occidentale* (cashew) and *Mangifera indica* (mango), measured by reverberation room method**

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Sound absorption barriers made of plants are used as an environmentally friendly solution to reduce noise pollution. In cities of Sri Lanka, noise pollution is one of the major problems that needs attention. This paper compares noise absorption power of two fruit plants, *Anacardium occidentale* (cashew) and *Mangifera indica* (mango), measured by 'reverberation room method'. The preliminary result presented here is part of an attempt to identify locally available plants as sound barriers. A reverberation room, with appropriate dimensions and diffusers to satisfy the ISO 354:2003 standard with uniform sound distribution in the working area, was designed and constructed to perform the experiment. B&K type 2250L hand-held analyzer, Dodecahedron Omni Directional B&K speaker, internal sound generator with B&K power amplifier and A16 Mega Pixel camera were the main equipment used. Plant holder with dimensions 2.4 x 2.4 m<sup>2</sup> was placed in the middle of the reverberation room to hang the testing plant samples. Speaker and the analyzer were placed at appropriate locations keeping 1m away from the sample and 1m above the ground. Special care was taken to keep plant samples alive during the process. Reverberation Time (RT<sub>30</sub>) was measured using reverberation room method. Thirty (30) measurements were taken for each plant sample, at three different locations of the analyzer, repeating 10 times at each location. The procedure was repeated for three different samples of each plant type. Sound Absorption Coefficient ( $\alpha$ ) was calculated using Sabine's formula. Variations of RT<sub>30</sub> and  $\alpha$  with frequency were plotted. RT<sub>30</sub> decreases and  $\alpha$  increases with the increase of frequency for both samples. *M. indica* (mango) had lower RT and higher  $\alpha$  than *A. occidentale* (cashew) in the frequency range (1000-3150 Hz) studied. At 2500 Hz,  $\alpha$  of *M. indica* ( $\alpha = 0.295$ ) is 28.8% higher than that of *A. occidentale* ( $\alpha = 0.229$ ) indicating mango plants are better than cashew plants for noise absorption. Further studies are in progress to study other plant types.

**Keywords:** Sound Barriers, Reverberation time, Reverberation room, Sound absorption coefficient

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