

RISTCON 2018

**Proceedings of
5th Ruhuna International Science and
Technology Conference**

February 15, 2018

ISSN: 1391-8796

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Foreword

The 5th Ruhuna International Science and Technology Conference (RISTCON 2018) was organized by the Faculty of Science, University of Ruhuna, Sri Lanka. The abstracts arisen from research work in diverse disciplines of Science & Technology have been peer-reviewed prior to acceptance. The abstracts have been edited to maintain language accuracy and page limits. An official electronic PDF copy of the book will be available at <http://www.sci.ruh.ac.lk/conference/ristcon2018> of University of Ruhuna website. Responsibilities of the content text of the abstracts included in this publication remain with the respective authors. No part of this serial publication will be reproduced in any form.

When citing the abstracts published, this serial publication is to be referred to as 'Proceedings of the 5th Ruhuna International Science and Technology Conference, Feb 15, 2018, University of Ruhuna'.

Editors

RISTCON 2018

Message from the Vice Chancellor, University of Ruhuna

It gives me great pleasure to write this message for the Proceedings of the 5th Ruhuna International Science and Technology Conference (RISTCON 2018) organized by the Faculty of Science, University of Ruhuna.

I believe that, this will provide an international platform for the interested academics, scientists, researchers and research students from Sri Lanka as well as foreign universities and institutes, to share research findings on various themes in Science and Technology.

I would like to extend my gratitude for the organizing committee for providing this forum for researchers, practitioners and educators to share knowledge on most recent innovations, trends and concerns, practical challenges encountered and the solutions adopted in the fields of Science and Technology.

Faculty of Science has given a high priority for research field. I appreciate very much for their continuous efforts to share their new knowledge and experiences with national and international community through organizing this conference.

Finally, I congratulate to organizers, presenters and all other participants for their effort to make RISTCON a reality under the flag of University of Ruhuna.

Senior Professor Gamini Senanayake
The Vice Chancellor
University of Ruhuna
Matara 81000
Sri Lanka

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 5th Ruhuna International Science and Technology Conference (RISTCON-2018) 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 a number of 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-2018 has received around 150 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-2018 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. Utilizing natural energy sources, rain water management, rehabilitating abundant paddy fields, reducing waste of human work hours, stopping waste of resources, properly managing and recycling household and commercial waste, enhancing and popularizing methods of reducing waste of fresh fruit, vegetable and fish harvests so that they can be almost utilized and the excess can be exported, providing adequate facilities for people with special needs, improving transport management in towns and cities, introducing efficient ways to stop wasting many years young manpower of school leavers and finding ways for providing children from pre-school up to secondary school levels more time to enjoy their life so that they can be more creative and innovative than present students are some of the areas randomly came to my mind from among many areas where the country still need ‘advanced’ and ‘specific’ to the country approaches with the guidance of researchers and academics.

I am sure, through the conferences like RISTCON-2018 and many more we would engage in the future, that our scientific community could address not only all above-mentioned areas but also in many other areas.

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 Jinasena W. Hewage, the Chairperson of the Organizing Committee of RISTCON-2018, and his team for their creative, effective and untiring efforts for making this conference a reality.

I hope and wish you all would enjoy the humanity and the hospitality of our community at the Faculty of Science of this university.

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

2018.02.15

Message from the Chairperson- RISTCON 2018

With the honour of being the chairperson of the conference, I am delighted to deliver this welcome message on behalf of the organizing committee of 5th Ruhuna International Science and Technology Conference. RISTCON-2018 provides an incomparable venue for researchers and professionals from various fields of science and technology across the globe to share their knowledge being gained through national and international researches. This is also a great opportunity for our researchers and academics to build the collaborations and links with national and international institutions for mutual benefits. RISTCON-2018 bundles up more than hundred presentations from national and international researchers of diverse disciplines from basic sciences to applied sciences and technology. A renowned scientist from Federal Drug Administration-USA, Dr. Thilak Kumara Mudalige nourishes the RISTCON-2018 by delivering the Keynote speech on Nanomaterials in Consumer Products while Dr. Kithsri Priyanjan Karunathilake enriches the conference with his plenary speech on Unraveling the Myths in Western Medicine. These altogether will uplift the Faculty of Science, University of Ruhuna to international arena in the context of research.

As the chairperson of the RISTCON-2018 organizing committee, I cordially welcome Senior Professor Gamini Senanayake, the Vice Chancellor and Professor Jayantha Pasdunkorale, Dean, Faculty of Science, University of Ruhuna. Thus, it is my great pleasure and honour to welcome Keynote speaker, Dr. Thilak Kumara Mudalige, renowned scientist from FDA-USA and plenary speaker, Dr. Kithsri Priyanjan Karunathilake, eminent consultant physician. I cordially welcome all the other distinguished guests, all the academic staff members, speakers and presenters, non-academic staff members, students and the other ladies and gentlemen.

Finally I would like to get this opportunity to thank my organizing committee especially to my joint secretaries Dr. Nihal Yapage who took all the hard work to his shoulder and Dr. Upeksha Hemamalie and to the department representatives, Dr. W. A. H. P. Guruge, Dr. Nadeeka Wikramasuriya, Dr. C. T. Wannige, Dr. B. G. S. A. Pradeep, Dr. W. A. Indika, Dr. K. B. Jayasundara and Dr. W. G. S. Manel Kumari.

Professor Jinasena W. Hewage
Chairperson - RISTCON 2018
Faculty of Science
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Keynote speech
**Application and characterization of nanomaterials in
 consumer products**

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Nanotechnology is science, engineering, and technology conducted at the nanoscale (1-100 nanometers). Nanoscience and nanotechnology are the study and application of extremely small things in diverse applications including chemistry, biology, physics, materials science, and engineering. Production and application of nanoparticles in consumer products is at an all-time high.

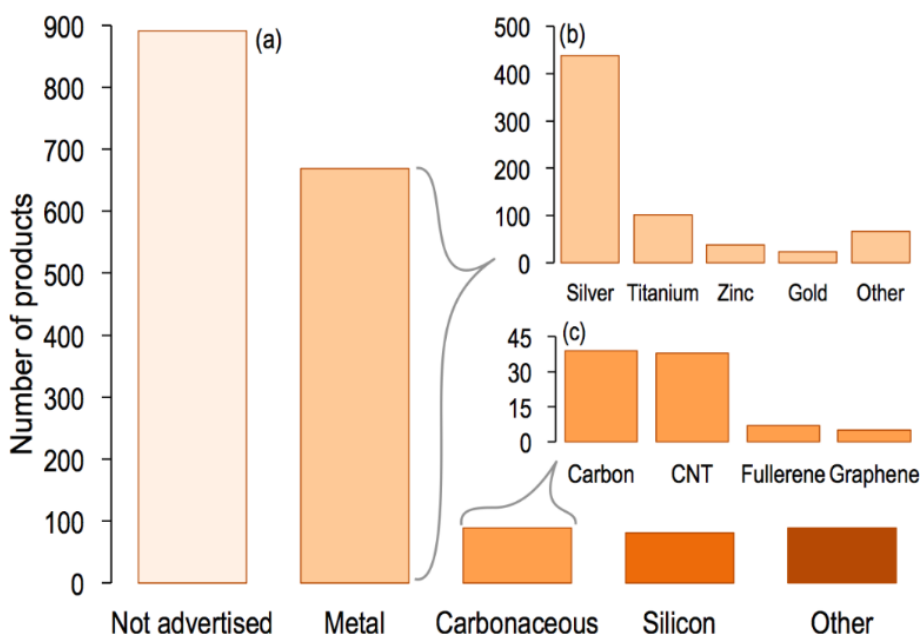


Figure 1: Composition of nanomaterials listed in the consumer product inventory (Beilstein J. Nanotechnol. 2015, 6, 1769–1780)

Direct detection and quantification of trace levels of nanoparticles within consumer products such as food, sunscreens, or dietary supplements, is an important challenge. Consumer products are often complicated mixtures that may contain inorganic nanoparticles composed of gold, silver, titanium dioxide or zinc oxide. It is important to understand the properties of nanoparticles that appear in consumer products. A variety of techniques are

used to describe metal content, elemental composition, oxidation state, size, size distribution, shape, and surface charge of nanomaterials. All of these often interrelated parameters can influence how nanomaterials interact with the consumer and the environment and may influence the behavior of the particle in a complex system.

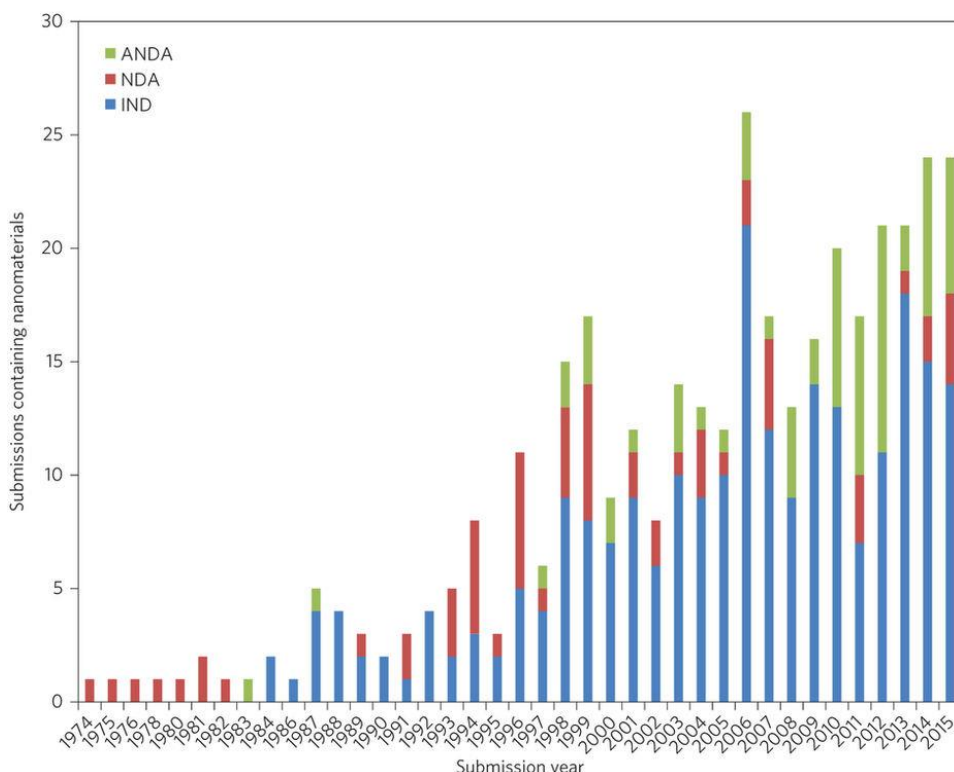


Figure 2: Number of nanomaterial product applications submitted to FDA by year (*Nature Nanotechnology* **12**, 523–529 (2017))

Nanomaterials are also used in drug formulations and/or targeted drug delivery systems. Their unique properties have led to an explosion of nanomaterial product applications submitted to the FDA (Figure 2). Liposomes are prime examples of organic nanomaterials currently used in approved drug formulations and dietary supplements. Liposomes are a closed compartment made up of phospholipid bilayer and an active pharmaceutical ingredient (API) which is either encapsulated inside the liposomes (Liposomal Doxorubicin) or trapped in the lipid bilayer (Liposomal Amphotericin B). Encapsulation of the API inside the liposome reduces the toxicity of the formulation related to the free API and increases

the circulation time of the formulation in the blood. Water insoluble APIs such as Amphotericin B, partition in the lipids bilayer of the liposomes provides the drug delivery mechanism. Encapsulated active ingredient content, lipid profile, size, and zeta potential are determined in the characterization of liposomal products.

This presentation will describe several developed methodologies for characterizing inorganic and organic nanoparticles using microscopy techniques, light scattering, size-based separation methods, elemental analysis, and mass spectrometry. Determination of the size and size distribution are most important parameters in the characterization of nanomaterials. Therefore, selected size based separation techniques for the characterization of nanomaterials will be presented in detail.

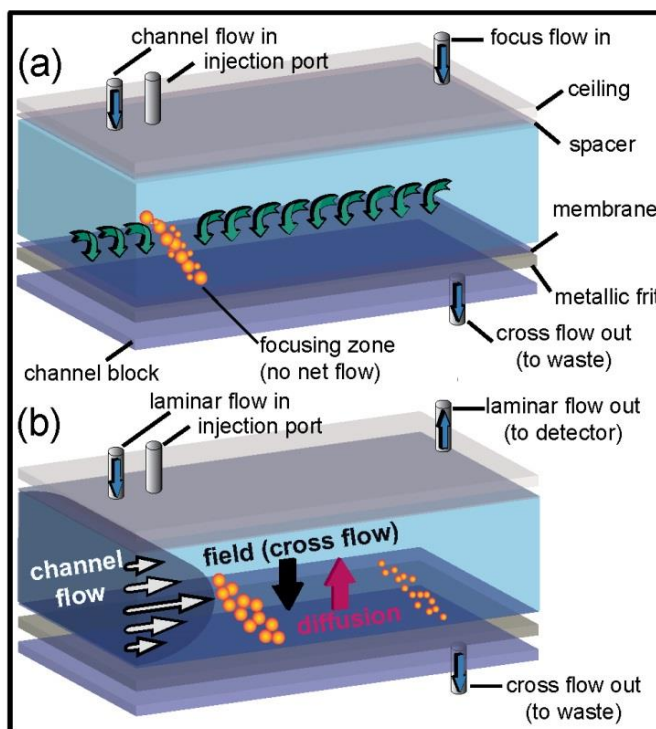


Figure 3: Schematic illustration of AF4 channel assembly showing the liquid flow profile during the (a) focusing and (b) separation steps

1. Asymmetrical flow - field flow fractionation (AF4)

AF4 is a diffusion based separation technique, which uses narrow ribbon shaped channel. One side of the channel is lined with porous membrane supported by metal frit. As indicated in Figure 3b, the liquid flow along the

channel (channel flow) creates a parabolic flow profile where center of the channel has a greater flow rate along the channel compared to flow rate at edge of the channel. As shown in Figure 3b. fraction of the liquid entering the channel passes along the channel and a fraction passes through the membrane providing a downward cross flow. The cross flow pushes nanoparticles towards the membrane and diffusion bring them back towards center of the channel. Smaller particles, having a higher diffusion coefficient, travel further away from membrane towards the center of the channel and move faster along the channel due to parabolic flow profile providing size based separation mechanism.

AF4 analysis consists of 2 steps, which are focusing and separation. In the focusing step, fluid is pumped into the channel from both ends simultaneously. All fluid entering the channel escapes as crossflow through the membrane and nanoparticles are concentrated as a narrow band, near the injection port where there is no net flow of fluid along the channel as schematically illustrated in Figure 3a. Focusing is an essential step to achieve good resolution in fractograms. In the separation step, analytes separate based on their size (diffusion coefficient) with particles eluting from smallest to largest.

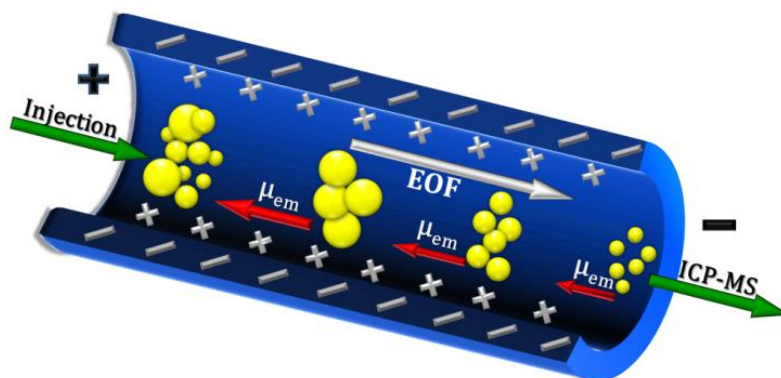


Figure 4: Illustration of the separation of a nanoparticle mixture using capillary electrophoresis

2. Capillary electrophoresis

Capillary electrophoresis uses narrow fused silica capillaries and an electric field to separate charged analytes according to charge and size. In normal mode of operation, the capillary's inner surface is negatively charged. Positively charged counter ions balance the charge of electrolytes within the

capillary and create a net positive free ion excess within the capillary. When a high voltage (0-30kV) is applied along the capillary, negative electrolytes migrate towards the anode and positive electrolytes migrate towards the cathode. Since there is an excess of free positively charged electrolytes, migration of cations creates a net fluid flow from the positive electrode to the negative electrode. This bulk flow of liquid based on the electric field is called electroosmotic flow (EOF). The EOF can be minimized by coating internal surface to make it neutral or direction of the flow can be changed by inverting surface charge of the inner wall of capillary. Unlike conventional pressure driven laminar flow profile (parabolic flow) electroosmotic flow generates a flat flow profile in narrow capillaries, which helps to minimize peak broadening in the separation.

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Unravelling myths and beliefs in western medicine

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Western medicine has evolved hundreds of years to the state we practise today. There has been enormous amount of data which has descent over the generations of physicians. It has been strengthened by many other streams such as physics, chemistry and biology and it continues to do so.

In the early years it has been mostly the clinical experience of physicians which was used as guidelines in the management of disease conditions. This information has been passed through generations and altered with new experience of physicians. It is not uncommon to practise this paternalism even at present. Over the last century there were many inventions in to the field of medicine; investigations such as ECG, Ultrasound scans, CT, MRI and PET scans and many blood investigations; new therapeutic interventions such as monoclonal antibodies in the treatment of cancer and rheumatic conditions are some of them. In par with all these inventions, research came into the field of medicine creating a paradigm shift.

The clinical research has contributed massively to the current practise of western medicine. The pioneering health organisations of developed countries started producing clinical practise guidelines making the practise standards more generalised among the countries.

To date, we as physicians follow these guidelines to help in the management of our patients in the background of a holistic approach towards individual patient.

The major obstacles that we find in the management of our patients are myths and beliefs about the medical conditions. Some of these have a scientific background whereas the others are simple myths. The basis of these myths is sometimes difficult to explore and research. However, some of these can be discussed in the context of evidence-based medicine.

It has become the need of today than ever as we have a growing influx of medical information from the internet and social media. It is very important to address these issues as much as possible to enlighten the community to improve their health status, health knowledge and to prevent clinical malpractices.

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Cell membrane integrity and proline content of *Rhizophora mucronata* Lam. seedlings under hypersaline and drought conditions

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The planted mangrove seedlings and propagules experience low soil water potential and hypersaline conditions when plants are introduced beyond and deeper in the intertidal area respectively. Severe leaf necrosis in planted mangroves is also commonly observed under these conditions. Based on this, it was hypothesized that the cell membranes of mangrove plants are critically damaged under hypersaline and drought conditions leading to extensive cell deaths in leaves and stem. We investigated the cell membrane stability of *Rhizophora mucronata* Lam., a commonly used species in mangrove restoration in Sri Lanka, by using electrolyte leakage method and assessing the proline content of leaves under three levels of moisture stress; 25% water holding capacity (WHC), 50% WHC and 100% WHC (control) and salinity levels; freshwater, high salinity (33-36 psu) and moderate salinity (13-15 psu: control treatment) where salinity and moisture treatments were separately maintained. Survival rate and growth performances like cumulative height, total leaf area of the plants were also studied. Both low survival (< 50%) and poor growth performances (dwarf plants with smaller leaf area) were observed in 25% WHC, 50% WHC and high salinity treatment levels, in which, significantly higher electrolyte leakage (>40%) and higher proline content (30-35 $\mu\text{mol g}^{-1}$) were further observed compared to the control and to the freshwater treatments ($p < 0.05$). The lowest proline content was, however, recorded in control treatments; moderate salinity ($8.8 \pm 1.5 \mu\text{mol g}^{-1}$) and 100% WHC ($6.5 \pm 1.2 \mu\text{mol g}^{-1}$). This indicates that, as a tolerant strategy, *Rhizophora* plants increased the proline content to protect cellular membrane, more likely from free radical activities. However, the high electrolyte leakages indicate that the membrane permeability of *Rhizophora* plants is collapsed. This cell disintegration results in cell deaths (small leaf necrotic regions) which are further developed to larger necrotic regions with time. The resultant dead tissues reduce photosynthetic capacity of the plants weakening the tolerant mechanisms further.

Keywords: Substrate dryness, hypersaline, cell membrane damage, proline, *Rhizophora*

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Change from hand milking to machine milking affects the milk yield and behavior of Jersey cross-bred cows

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Sudden changes in routine practices may result in behavioral changes and even reduce the milk production of milking cows as it causes stress to the cows. Objective of the present study was to reveal the effects of changing milking method from full hand milking (HM) to machine milking (MM) on cow behavior and milk yield. Randomly selected seven Jersey cross-bred cows at second lactation were used in the study. Data were first collected following hand milking and after one week adaptation period same animals were used to collect the data under machine milking. Milk yield (morning) and the behavioral bouts, namely aggressiveness (AG), wagging tail (WT), urination, excretion, bellowing (BL), kicking (KI), in pain (IP), licking the calf, eating and drinking were recorded. Behavior study was done by following an ethogram. Behavioral data were obtained continuously covering morning milking time and frequencies of attending each behavior were recorded. Mean milk yield was significantly ($p < 0.05$) higher in cows under HM (4891 ± 186 mL/day; SE) compared to MM (2838 ± 186 mL/day; SE) in DMRT procedure. Expression of behaviors such as AG (23%), WT (4%), BL (24%), IP (53%) and KI (17%) was significantly higher ($p < 0.05$) under MM compared to the same behaviors under HM (21%, 3.1%, 18%, 42%, and 16%, respectively). It is concluded that sudden shift of HM to MM reduce the milk yield and increases the expression of stress behaviors in Jersey cross-bred dairy cows.

Keywords: Behavior, cow milk, hand milking, machine milking

Acknowledgement: Mr. U.D. Belpagodagamage, Farm Manager/ Faculty of Agriculture, University of Ruhuna is acknowledged for arranging the experimental facility.

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Fluctuations of seasonal paddy production on food security in Sri Lanka

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Food security refers to the ability of everybody to access the sufficient, safe and nutritious food to meet their daily dietary needs and food preferences to be well and active. While Sri Lanka is in 66th place in global food security index in 2017, rice is the staple food and paddy cultivation is the major agricultural activity of Sri Lankan farmers. However, paddy production is highly fluctuated with the seasonal variations. Therefore, this study was carried out to analyze the impact of paddy seasonality on food security in Sri Lanka. The secondary data available from the period 2000-2012 was used for the analysis where Pearson correlation test was performed to develop the relationship. In order to find out the relationship between seasonal paddy production and food security, following food security measures were considered; diet quality, diet quantity and current economic vulnerability. Results revealed that there is a positive correlation between diet quality parameters and current economic vulnerability with the seasonal paddy production. However, the indicators of diet quantity showed a negative impact on food security. Therefore, it can be concluded that the overall food security level of Sri Lankan consumers is affected by the fluctuations of seasonal paddy production in Sri Lanka.

Keywords: Food security, rice, seasonality

Acknowledgements: *I wish to express my heartiest gratitude to my supervisor Prof. Mahinda Wijerathne and all other supporters who helped me to conduct this research effectively.*

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Evaluation of shelf life of biocontrol agent *Trichoderma* isolate T13 with different formulations

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Trichoderma isolate T13 has been identified as a potential biocontrol agent against the Panama wilt pathogen *Fusarium oxysporum* f. sp. *cubense* and it can be produced in mass quantities *in-vitro*. However better formulation is required for field applications. Therefore, here we report the evaluation of different formulations of *Trichoderma* isolate T13 in relation to its shelf life. As carrier materials, Talcum powder and Lignite were used in different ratios as follows (t1=0:50, t2=1:4, t3=2:3, t4=1:1, t5=3:2, t6=4:1, t7=50:0) and 10 mL of concentrated conidia suspension (6.16×10^9 conidia/mL) of T13 was added to each treatment for the preparation of formulations. The best ratio was selected by assessing colony forming units (cfu/g) of *Trichoderma* T13 culturing in *Trichoderma* selective media at every 4 weeks intervals after inoculating into the sterilized soil. It has been revealed that 4 weeks after inoculation of soil, T13 population was significantly increased in all treatments ($p < 0.05$) except t6 and t7 compared to T13 population at day zero. At 8th week of the post-inoculation, cfu/g of t2 significantly increased ($p < 0.05$) while in other treatments' cfu/g was increased but not significant compared with 4 weeks of the post inoculation. At 12th week of the post inoculation, fecundity (cfu/g) of t2 significantly increased ($p < 0.05$) while cfu/g of t3 and t4 was insignificantly decreased. At the same time, viability of T13 in t1, t5, t6 and t7 was diminished significantly (cfu/g). However, cfu/g of t2 was started to reduce after 16 weeks of the post-inoculation and the t1, t3, t5, t6 and t7 showed decreasing trend with the time. According to the results, during 20 weeks from post-inoculation, formulation t2, showed significant conidia viability of *Trichoderma* isolate T13. Therefore, it can be concluded that, Talcum; Lignite 1:4 would be the best ratio for the formulation of T13 conidia for field application.

Keywords: *Trichoderma*; Formulation; Shelf life; Viability

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Identification of metallothionein gene in *Staphylococcus warneri* strain G isolated from industrial effluent in Sri Lanka

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Controlling pollutants has become a crucial requirement with the world's population increase and urbanization. Studies on bacteria with metal tolerance capabilities have revealed the presence of heavy metal tolerant mechanisms and their potential use in bioremediation. Identification and isolation of genes that confer metal resistance in bacterial isolates is important as they can be used to modify organisms using genetic engineering to enhance bioremediation abilities. Metallothionein is an intracellular protein found in both prokaryotes and eukaryotes that has the ability to bind heavy metals *via* thiolate bonds and thereby reduce the toxic effects of heavy metal ions to living organisms.

Heavy metal tolerance analysis showed that *Staphylococcus warneri* strain G, which has been previously isolated from a textile dyeing industry has metal tolerance ability in the order of Pb^{2+} (1000 ppm) > Cd^{2+} (100ppm) > Cu^{2+} (25ppm). Although metallothionein gene is known to present in *S. epidermidis* genome, it has not yet been assigned in any of the *S. warneri* genomes. Primers were designed exploiting the *S. epidermidis* gene sequences to amplify a region of 295 bp flanking the complete metallothionein gene and to amplify a region of 628 bp which included the complete sequence of the possible regulator gene along with the complete metallothionein gene of *Staphylococcus spp.* Both Polymerase Chain Reaction amplifications resulted bands of expected sizes for *S. warneri* strain G where the nucleotide sequencing of the two amplicons showed a similarity of 98% for the complete metallothionein gene and for the complete regulator gene present in *S. epidermidis* 949_S8. It was concluded from the above study that *S.warneri* strain G has the potential to synthesize metallothionein which can contribute in the heavy metal tolerance of *S.warneri* strain G.

Keywords: Metallothionein, *Staphylococcus warneri*, Genetic engineering, Bioremediation

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***In-vitro* screening of ethyl methanesulfonate (EMS) treated shoot tips of banana for *Fusarium* wilt using crude culture filtrates of different *Fusarium oxysporum* isolates**

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Fusarium wilt is the most serious threat to commercial cultivation of many banana varieties including Kolikuttu; a variety with high consumer demand in Sri Lanka. The improvement of banana through conventional methods is hampered by the sterility and polyploidy of the plant. Therefore, mutagenesis could be used as a viable option to induce genetic variations. In the present study, *in-vitro* mutagenesis using the chemical mutagen; ethyl methanesulfonate (EMS) was undertaken to develop *Fusarium oxysporum* f.sp. *cubense* (foc) resistant or tolerant Kolikuttu banana. In order to facilitate screening of large number of plants, *in-vitro* screening technique was adopted, and crude culture filtrates of the pathogen were prepared using PCR confirmed race 1 of foc. Culture filtrate was added separately to the prior sterilized Murashige and Skoog (MS) medium at 15% as the selection factor along with control. The differences of explant survival and *in-vitro* growth and multiplication of shoot bud clusters were observed with 3 different isolates of the pathogen collected from different areas. The results showed that survival and multiplication rate of shoot tip explants were reduced by different isolates. *In-vitro* growth performances were also retarded by the crude culture filtrate. However, no significant differences were observed in the parameters (gain of fresh weight, gain of buds and the shoot height) measured among the culture filtrates of three different isolates. The plants recovered after 2 selection cycles of *in-vitro* screening were weaker than control plants and had poor survival during hardening period. The hardened plants need to be further tested and validated for the disease resistance or tolerance.

Keywords: banana, crude culture filtrate, *Fusarium oxysporum* and *in-vitro* mutagenesis

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Amine oxidases of *Arabidopsis thaliana* are potential candidates of abscisic acid signalling

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Polyamines (PAs) are essential growth regulators present in all living organisms. PAs are oxidatively catabolized by two groups of amine oxidases namely copper-binding diamine oxidases (CuAO) and FAD-binding polyamine oxidases (PAO). Seven genes coding for *CuAO* and five genes coding for *PAO* are identified in *Arabidopsis*. PAs and amine oxidases play an array of roles in physiological processes of plant growth and development and in plant abiotic and biotic stress responses.

Potential involvement of *CuAO* and *PAO* was tested for the role in nitric oxide (NO) signalling and ABA-mediated stress responses. Fluorimetric and fluorescence microscopic studies revealed that ABA-induced NO production was impaired in knockouts of *CuAO1* and *PAO2* compared to wild type (WT). The observations suggest possible functions of *CuAO1* and *PAO2* in ABA-mediated NO signalling. Further, ABA-induced H₂O₂ production was impaired in the knockouts indicating role of *CuAO1* and *PAO2* in H₂O₂ production. Morphological analysis with the knockouts and over-expressors showed differential sensitivity to exogenous application of ABA during seed germination, seedling establishment and root development. The results of ABA-induced NO production and growth responses suggest *CuAO1* and *PAO2* as potential signaling candidates linking ABA and NO.

Keywords: *polyamine, amine oxidases, nitric oxide, ABA, signalling*

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Effects of water deficit stress on growth, leaf relative water content and stomata density of *Capsicum annum* L.cv. CA8

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Water deficit stress is one of the main factors that can affect growth in species of *Capsicum annum* L. worldwide. The newly developed cultivar of *Capsicum annum* L.cv. CA8 by the Department of Agriculture, Sri Lanka would also be no exception. The effects of water deficit stress on this new cultivar were studied in a pot experiment by withholding water supply in gaps of days making four irrigation treatments. Scheduled watering was done in vegetative and reproductive stages separately in two experimental setups until the end of the life span of the plants. The results obtained showed that the water stress developed in plants increased with the increase of gap in irrigation, leading to reduction of growth, relative water content and stomata density of *Capsicum annum* L.cv. CA8. The irrigation treatment that eliminated temporary wilting showed fewer effects on the measured parameters when compared with plants under watering cycles with more than five days gaps. The decrease in growth parameters of *Capsicum annum* L.cv. CA 8 could be attributed to reduction in photosynthetic capacity in the plants that were affected by water deficit stress developed in them. Reduction of leaf relative water content and stomata density may be considered as direct effects of water deficit stress developed in these plants.

Keywords: *Capsicum annum* L. cv. CA8, Irrigation treatment, Water deficit stress

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Life history aspects of two monophagous insect species feeding on *Calotropis gigantea* in Sri Lanka

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Calotropis gigantea is a plant native to Sri Lanka with an Ayurvedic medicinal value, yet it is known to be invasive in countries where it has been introduced. *Dacus persicus* and *Paramecops farinosus* (Aak weevil) are monophagous insects that feed on *C. gigantea*. Present study is aimed to elucidate the life history aspects of *D. persicus* and *P. farinosus* with their damage to the plant, in order to assess the potential of them to be used as a bio-control agent against *C. gigantea* in countries where the plant is invasive. The field sampling was done throughout the island covering 108 sampling sites during December 2014 to October 2015, and *C. gigantea* fruits were examined for life stages of the two insect species, and for any signs of damage to the fruit. *D. persicus* eggs were found in seed chamber as only one cluster of eggs per fruit, and three larval instars were recorded feeding on *Calotropis* seeds. Infected fruits drop pre-maturely with fully developed larvae inside. Subsequent pupation takes place in soil, and cocoons are creamy white and cylindrical in shape. Similarly, *P. farinosus* lay yellowish, oval and mostly one-clustered eggs in the inner-pericarp fibrous layer of the *Calotropis* fruit. Newly emerged larvae were apodous, pale yellowish-white with brown head capsule whereas developing larvae were creamy-white, curved and stout. *P. farinosus* larvae voraciously feed on *Calotropis* seeds while adults feed on leaves, buds and flowers. Fifth larval instar of Aak weevil pupated by forming silky cocoons within seed chamber of *Calotropis* fruits. Both species being seed predators highly damage reproductive structures of *C. gigantea*, thus directly influences on reproductive output of the plant. These results provide baseline information needed in adopting *D. persicus* and *P. farinosus* as potential bio-control agents against *C. gigantea*.

Keywords: Bio-control, *Calotropis gigantea*, *Dacus persicus*, invasive species, *Paramecops farinosus*

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Anti-hypercholesterolemic activity of *Phyllanthus reticulatus* (Wel-kyla) and *Glochidion zeylanicum* (Hunukirilla) methanolic extracts on Wistar albino rats (*Mus norvegicus albinus*)

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Over accumulation of cholesterol in blood leads to hypercholesterolemia with severe health consequences. The present study focused the dose-dependent response of crude methanolic extract of air dried *P. reticulatus* (PR-CME) and crude methanolic extract of *G. zeylanicum* (GZ-CME) in Wistar albino rats to determine the effective dose. Crude methanolic extract of each plant sample was obtained by Soxhelt extraction using 80% methanol and concentrating by rotary evaporator and vacuum oven. A hypercholesterol diet was orally introduced to male rats (n = 6/group). Air dried PR-CME and GZ-CME extracts of the dosage of 800 mg/kg, 1200 mg/kg and 1600 mg/kg were administered orally once a day for forty two (42) days and blood parameters were measured from the date of commencement and subsequently on 14th, 28th and 42nd days. Increasing PR-CME and GZ-CME concentrations showed dose dependent negative responses ($p \leq 0.05$) with total cholesterol, triglycerides and LDL-C while dose dependent positive response ($p \leq 0.05$) with HDL-C. By the 42nd day of the experiment PR-CME1600 (77.78 ± 1.44) and GZ-CME1600 (83.48 ± 4.37) treated groups reached the normal total cholesterol level of the NCG (78.14 ± 4.68), making the total cholesterol levels insignificant ($p > 0.05$). At the end of the experiment PR-CME1600 (52.07 ± 2.27) treated group reached the normal HDL-C levels of the NCG (57.06 ± 3.15) indicating insignificantly different HDL-C levels ($p > 0.05$). Compared to cholesterolemic untreated group, the levels of total cholesterol, triglyceride and LDL-C were significantly decreased in all three doses of PR-CME and GZ-CME ($p \leq 0.05$). The crude methanolic extract of *P. reticulatus* was able to lower the levels of total cholesterol and increase HDL-C level up to normal level in rats within 42 days and *G. zeylanicum* was able to lower the level of total cholesterol in rats up to normal level within 42 days of treatment. The appropriate most effective dose is 1600mg/kg body weight.

Keywords: Cholesterol, Wistar albino rats, *Phyllanthus reticulatus*, *Glochidion zeylanicum*

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Synthesis and biological activity studies of a novel highly functionalized 2-methylbenzoxazole derivative

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Derivatives of benzoxazole are an important class of heterocyclic compounds with many potential biological activities. In this work, a benzoxazole enol-ester, (Z)-2-(benzo[d]oxazol-2-yl)-1-(4-methoxyphenyl) vinyl-4-methoxybenzoate, was synthesized by reacting 2-methylbenzoxazole (1 equiv.) with 4-methoxybenzoyl chloride (2.1 equiv.) in the presence of triethylamine (3 equiv.) in diglyme and heating in a water bath for 3 h. The product was isolated as a pale yellow solid (m.p. 155-158 °C) in 2.3% yield. The ¹H and ¹³C NMR spectra clearly indicate the presence of two methoxy groups (¹H: δ 3.87 and 3.97 ppm; ¹³C: 55.46 and 55.59 ppm), and the vinyl proton (δ 6.93 ppm) and the vinyl carbon (δ 101.3 ppm) of the product. The α-amylase enzyme inhibitory assay conducted at 0.25, 0.50, 1.0 and 2.0 mg/mL exhibited 8%, 51%, 59% and 69% inhibitions, respectively. Antioxidant activity, determined using the DPPH radical scavenging assay at 2.0 mg/mL, showed only a 10% radical scavenging activity. The product did not show significant antibacterial activity against *Escherichia coli* and *Bacillus subtilis* at 1.0 mg/mL in the disk diffusion assay. In conclusion, the synthesized highly functionalized benzoxazole derivative shows significant α-amylase enzyme inhibitory activity.

Keywords: 2-methylbenzoxazole, 4-methoxybenzoyl chloride, enol-ester, α-amylase enzyme inhibitory activity

Acknowledgement: Authors acknowledge the financial assistance by the University of Colombo (AP/3/2/2016/SG/19).

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***Cassia auriculata* and *Cyperus rotundus* as green corrosion inhibitors in hydrochloric acid**

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Methanol extracts of *C. auriculata* and *C. rotundus* rich in antioxidants were chosen as corrosion inhibitors and their inhibition efficiencies were studied using weight loss measurements, linear sweep voltammetry and Tafel extrapolation method. The optimum concentrations of *C. rotundus* and *C. auriculata* which caused the highest inhibition efficiencies were 1100 and 600 ppm respectively. Both the inhibitors followed Langmuir, Temkin and Freundlich adsorption isotherms and the calculated adsorption Gibbs free energies ($\sim -20 \text{ kJ mol}^{-1}$) suggest physisorption of both inhibitor molecules on the steel substrate. Corrosion potential of the steel substrate in HCl is -0.709 V. In the presence of *C. rotundus* (1100 ppm) and *C. auriculata* (600 ppm) the corrosion potential shifted to more negative values, -0.746 and -0.765 V. Calculated corrosion current densities from Tafel extrapolation method are 1.45×10^{-4} (HCl), 0.79×10^{-4} (*C. auriculata*) and $0.60 \times 10^{-4} \text{ A/cm}^2$ (*C. rotundus*). These values indicate mixed type inhibition. The negative shift of corrosion potential in the presence of inhibitors suggests their predominant control over cathodic reaction. The results of this work indicate that methanolic extracts of both *C. auriculata* leaves and *C. rotundus* rhizomes can be used as green corrosion inhibitors in acidic medium.

Keywords: *Cassia auriculata*, *Cyperus rotundus*, green corrosion inhibitors

Acknowledgements: Assistance from Dr. J. W. Hewage and Dr. K.R. Fernando is highly acknowledged.

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Synthesis of magnetic iron oxide nanoparticles using an aqueous extract of *Eichhornia crassipes* (Water Hyacinth)

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Iron nanoparticles have been extensively studied, synthesized and used in many applications due to its distinctive characteristics such as magnetic properties and biocompatibility. Conventional synthetic methods utilize toxic and potentially hazardous chemicals which lead to various biological and environmental risks. Thus, a green synthesis of iron oxide nanoparticles has explored to establish an eco-friendly, economical method, using an abundant plant species in Sri Lanka. Invasive plant *Eichhornia crassipes* (water hyacinth) is a good candidate towards developing a greener synthetic method due to the presence of sulfated polysaccharides that act as a strong reducing agent during the synthetic process. Phytochemical screening was carried out to identify the phytochemicals present in aqueous and methanolic extracts of the plant. Both extracts were rich in alkaloids, saponins, steroids and carbohydrates. Iron oxide nanoparticles were synthesized by aqueous extract of freeze-dried petiole parts of *Eichhornia crassipes* and 0.08 M FeCl₃.6H₂O as the iron precursor. Sulfated polysaccharide coated, moderately stable and water-soluble iron oxide nanoparticles were obtained from the synthesis at 45 °C. Size of the nanoparticles was determined using a particle analyzer and the mean diameter of synthesized NPs is 50-120 nm and about 61% from the total population is below 100 nm. FTIR spectroscopic data of synthesized nanoparticles supported the fact that nanoparticles are functionalized with negatively charged sulfated polysaccharides. It is further proved by the negative zeta potential value (-23.7 mV). PXRD analysis results showed that synthesized particles were amorphous in nature. Proper modifications of this greener method have a huge potential towards developing more efficient iron oxide nanoparticle synthetic method while adding value to invasive plant *Eichhornia crassipes*.

Keywords: green synthesis, iron oxide nanoparticles, *eichhornia crassipes*, sulfated polysaccharides

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Production of lipase by *Fusarium oxysporum* using Mee (*Madhuca longifolia*) oil cake substrate and its potential applications in detergent industry

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Enzyme lipase was produced by *Fusarium oxysporum* under solid state fermentation using Mee (*Madhuca longifolia*) oil cake as the substrate. Conditions were optimized to obtain the maximum production of lipase by varying incubation time, pH, substrate level, and additional nitrogen source. Maximum production was obtained at pH 8, in 7 days at a substrate level of 330 g/L. For large scale preparation of the enzyme, cultures were grown under the optimized conditions, extracted enzyme was fractionated with ammonium sulphate, dialyzed and the potential of the enzyme to be used in detergent industry was evaluated. Substrate specificity, stability of the enzyme in the presence of commercial detergents and fatty stain removal ability were also investigated. This study revealed that the enzyme has a relatively higher substrate specificity towards castor, coconut and olive oils whereas relatively low substrate specificity towards the sunflower oil. Enzyme also showed relatively higher stability towards the detergents: Diva, Sunlight and Rin while comparatively low stability towards Surf excel. It was also found that the produced lipase possesses an ability to remove fatty stains.

Keywords: *lipase*, solid state fermentation, application in detergent industry, *fusarium oxysporum*, *mee (madhuca longifolia)* oil cake.

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Lead pollution in road side dust in selected locations in Matara district

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Road dust pollution of Pb due to mobile or stationary sources such as vehicular emission, industrial plants, power generation plants, oil burning, waste incineration etc. is a recent health hazard in urban areas. Therefore, this study was focused on analysing road side dust in order to evaluate the Pb pollution at different locations in Matara district. The samples were collected in September, 2016 from each site under similar weather conditions and digested with conc.HNO₃ acid Pb was determined using atomic absorption spectrophotometry. The limit of detection and quantification for the method were 0.02 mg/L and 0.106 mg/L respectively under the acceptable accuracy level of the analytical method (90%). The concentration of Pb at 60 sites in Matara urban area varied between 6.31 – 15.00 mg/kg. The lowest Pb concentration (1.75 mg/kg) was observed at Aperakka area which can be considered as rural and the highest value (15 mg/kg) was observed in Matara urban area that confirmed the effect of automobile emissions combined with possible other sources contributing to Pb pollution. The ranges of concentration were observed as 1.75 – 6.50, 4.50 – 10.20, 3.50 – 9.50 mg/kg respectively at Aperakka, Dondra and Gandara areaz. Since, there was a significant difference of Pb concentration in the road dust samples there could be sources of Pb emissions at certain areas. However, the concentrations of Pb in the road dust samples were considerably lower than in other areas (Colombo) of Sri Lanka, and that could be due to short history of urbanization, and industrialization in Matara district.

Keywords: road dust, lead pollution, atomic absorption spectrophotometry.

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Determination of cadmium in rice using mercury and bismuth coated carbon electrodes by voltammetric techniques

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Anodic Stripping Voltammetry (ASV) is a potentiodynamic technique, which is capable of measuring concentrations of different metal ions simultaneously, was used in this research. Four different methods were developed for determination of cadmium content in digested rice samples from the Hambantota district. This district has been identified as a possible chronic kidney disease (CKD) area and it has been hypothetically assumed that one of the causes of CKD could be due to high intake of Cd through drinking water and food. The samples were collected from four rice mills in the vicinity of Thissamharama. Four methods developed in this research work were based on coating glassy carbon and carbon disk electrode surfaces with thin films of mercury (TFM) and bismuth (TFBi) and subsequent attachment of cadmium to these surfaces under constant potential coulometric (CPC) conditions. Then Cd was stripped off using a liner sweep voltametric (LSV) step. The electrochemical parameters such as deposition and stripping potential and scan speed were optimized using known concentrations of Cd. The stripping current has been used to calculate the concentration of Cd by means of appropriate calibration plots. Of the four possible combinations investigated in this work, it was observed that depositing Cd on TFM gave the best option. The accepted level of cadmium in rice, according to WHO, is 0.4 mg kg^{-1} of rice. The maximum Cd concentration determined in this study was 0.2 mg kg^{-1} for rice varieties from Hambantota district. It can be concluded that Cd content of the rice samples investigated in this study are not contaminated as per WHO standards.

Keywords: *Linear sweep voltammetry, Cadmium, Anodic Stripping voltammetry, Controlled potential coulometry, chronic kidney disease.*

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Leaves and fruit pericarp of *Garcinia zeylanica* Roxb. as a potential anti-diabetic agent

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Type-2-diabetes (Diabetes mellitus) is a common endocrine metabolic disorder diagnosed by hyper blood glucose levels or progressive deterioration of glucose tolerance. Most predominant among therapeutic approaches is the reduction of carbohydrate absorption after food consumption via inhibition of most responsible gastro intestinal enzymes related with carbohydrate metabolism. As the synthetic drugs with this action are incorporated with many adverse effects, search for alternative is a major concern in medicinal chemistry. Utilization of *Garcinia* in Ayurvedic medicine led to the focus of current study on *G. zeylanica*. The leaves and the pericarp of ripe fruits of *G. zeylanica* were tested for total polyphenols, flavonoids, *in vitro* antioxidant and inhibitory potential against α -glucosidase and α -amylase after soxhlet extraction with 70% methanol and 90% ethanol separately. Total polyphenolic (11.28 ± 1.04 mg/GAE g) and total flavonoid contents (9.84 ± 1.71 mg/ QE g) were higher for 70% methanolic extracts of leaves than fruit pericarp along with the highest antioxidant potential (80.01 ± 0.89 %). According to IC₅₀ values high inhibitory potential against alpha amylase (1.88 μ g/ml) and alpha glucosidase (5.40 μ g/ml) was also observed for *G. zeylanica* leaves indicating the substantial bioactivity against Type-2-diabetes. Therefore the results of this study suggest that the selected species could play a major role as an antidiabetic agent thus has the potency to employ in developing antidiabetic regimen.

Keywords: Alpha amylase, Alpha glucosidase, *Garcinia.zeylanica*, antidiabetic

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Sediment quality in Hambantota Harbour basin: a baseline assessment

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Water column processes are recorded in sediments. Accumulated allochthonous and autochthonous organic matter finally store in sediments. The concentration of this sedimentary organic matter can be used as an indicator for the trophic state. Metal molecules may act as a record of the input of contaminants. The aim of the study was to investigate the sediment quality of Hambantota harbour with reference to selected metals and organic matter. Triplicate sediment samples were collected from 13 sampling sites each covering inner and outer harbour areas of the Hambantota harbour. Samples were digested in Kjeldhal digestion system and analyzed using Atomic Absorption Spectrometer to determine the Pb, Ni, Cu and Zn concentrations. The concentration of metals was assessed against the Background Assessment Concentrations (BACs) and Effects Range Low/Effects Range Median (ERL and ERM) concentrations. Organic matter content was determined by using loss on ignition (LOI) method according to the CRIMP protocol. According to the results, Zn is the most prominent metal in all stations and ranged between 13.57 ± 4.8 and $239.2 \pm 9.3 \mu\text{g g}^{-1}$ (dry weight) followed by Cu (39.1 ± 9.0 and 97.1 ± 12.7), Ni (0.5 ± 0.2 - 113.9 ± 8.6) and Pb (9.9 ± 3 - 44.4 ± 6.4). Although Ni concentration in all stations showed above ERM concentration, none of the other metals did not exceed the ERM concentration. The organic matter percentage did not vary significantly ($p > 0.05$) between inner harbour and outer harbour sites although its range was between $0.38 \pm 0.04\%$ and $12.42 \pm 0.05\%$. Overall results highlighted that the sedimentary environment in Hambantota harbour is only exposed to lowest and moderate contamination levels of heavy metals.

Keywords: Inner and outer harbor, organic matter, sediments

Acknowledgement: *The support from Port Biological Survey Project conducted by Marine Environment Protection Authority is gratefully acknowledged.*

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Tolerance of Rose Balsam (*Impatiens balsamina* L.), to grow on soil contaminated by used automobile lubricating oil

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Soil contamination with used lubricant oil (ULO) has become an emerging global environmental issue due to its negative impacts on soil and biota. Phytoremediation is a novel, environmental friendly technique that has potential to be utilized in remediation of ULO contaminated soil. Screening of plant species expressing tolerance to growth on contaminated soil is the most critical step in the planning of a phytoremediation program. The aim of the present study is to investigate the tolerance of Rose Balsam (*Impatiens balsamina* L.) to grow in ULO-contaminated soil. Results of the preliminary experiment showed 100% seed germination after 96 hours of incubation in soils treated with 1-5% w/w ULO levels similar to that of uncontaminated control. This result indicates high tolerance of *I. balsamina* L. to germinate on ULO contaminated soil. The continuation of preliminary experiment for 120 hours showed the significant ($p < 0.05$) reduction of root length and root biomass of seedlings in all treatments above 3% w/w ULO. A pot experiment was conducted using fully randomized block design (RBD) with contamination levels of 0% (control), 0.5%, 1%, 1.5%, 2%, 2.5% and 3% w/w ULO with four replicates. The percentage biodegradation of ULO in different treatments indicated time dependent increase. The percentage biodegradation at three months was 46.3%, 38.5%, 31.4%, 26%, 20.22%, and 18.5% for 0.5%, 1%, 1.5%, 2%, 2.5% and 3% w/w ULO treatments, respectively. The measured growth parameters of *I. balsamina* grown in soils contaminated with >1% w/w ULO indicated significant negative effects. There were no significant differences in chlorophyll contents of plants grown in different treatments. Therefore, the present study concludes the tolerance of *I. balsamina* L. to grow in soil up to 1% of w/w ULO contamination levels without showing any negative effect. The results further highlighted that *I. balsamina* L. could be used in phytoremediation of soil contaminated with even higher levels of ULO (3% of w/w) if grown for long term such as 12 months.

Keywords: *Impatiens balsamina* L. phytoremediation, tolerance, used lubricating oil

Acknowledgments: Financial assistance received from National Research Council, Sri Lanka (Grant No. 16-144) is gratefully acknowledged.

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Investigation of a suitable metal catalytic system for the aldol reaction between acetophenone and benzaldehydes

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This study was aimed at finding an efficient metal ion catalytic system for the aldol reaction because waste generation in the conventional aldol reaction under standard condition is very high. The aldol reaction between aryl aldehydes (benzaldehyde, *p*-Br-, *p*-Me- and *p*-OMe- benzaldehydes) and ketones (acetone, cyclohexanone and acetophenone) was carried out with a catalytic amount of a metal salt (10% w/w) under refluxing conditions in different solvents. Of the metal salts used *viz* FeCl₃, ZnCl₂, TiO₂ and AlCl₃, FeCl₃ performed as the best catalyst for the aldol reaction between *para*-tolualdehyde and acetophenone. Among the three solvents (EtOH/ H₂O, CH₂Cl₂ and dioxane) examined, a mixture of EtOH and H₂O was found to be the best solvent system. Several ligands *viz* ethylenediamine, PPh₃, pyridine, aniline in different ratios were added to the reaction mixture to improve the yield of the aldol reaction catalysed by FeCl₃. Among them ethylene diamine with FeCl₃ in 1:3 ratio gave the best catalytic system. In addition, iron (III) catalysed aldol reactions carried out at 100°C produced the best yields in 3 hours. Final products were analysed by thin layer chromatography and compared with authentic samples. In conclusion, 10% FeCl₃, 30% ethylenediamine in EtOH/ H₂O solvent system was found to be the optimum condition for the aldol reaction and the highest yield of 35% was obtained for the reaction between acetophenone and *para*-tolualdehyde under this new unconventional condition with little or no waste.

Keywords: Aldol reaction, FeCl₃, ethylenediamine, EtOH/H₂O, catalyst

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Investigation of the best method for extraction of fish anesthetic compounds from common tephrosia (Kathurupila); *Tephrosia purpurea* leaves and effects of the extracts on fish (guppies)

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Use of aqueous extract of common tephrosia (Kathurupila); *Tephrosiapurpurea* leaves as an anesthetic agent is a traditional fish catching technique while scientific information on this regard is scarce to our knowledge. Thus, present study was designed to find the best extraction conditions and to evaluate the anesthetic properties of 'Kathurupila' (*Tephrosia purpurea*) leaf extracts using guppies (*Poecillia reticulata*) as experimental fish. The active components in leaves which have the potential to anaesthetizing fish were extracted using two different methods *viz* sequential extracting and solid-liquid extraction techniques. First sequential extracting technique was employed to extract active compounds in dried leaf sample (80 g) using the Soxhlet extractor with hexane, dichloromethane, ethyl acetate and methanol. The anesthetic activities of those extracts were tested on guppies (*Poecilia reticulata*). Preliminary studies showed that the methanol extract (yield 4.8 %) was active for fish. Secondly, solid-Liquid extraction was performed using crushed dried leaves (400 g) of the same plant with hexane, dichloromethane, ethyl acetate and methanol as the solvents. Anesthetic effect was assessed for each of these extracts and the ethyl acetate extract (2.1 %) was found to be the most active extract. Phytochemical screening of the ethyl acetate extract showed that it contains flavonoids, saponins, glycosides, tannins and phenols. A range of concentrations (0.3-0.6 g L⁻¹) of ethyl acetate extract was tested on guppies (average weight 0.729 ± 0.05 g and average length 3.3 ± 0.1 cm) to find the effective concentration. The observed induction time (10.3 min) and the recovery time (3.5 min) of the fish with a concentration of 0.6 g L⁻¹ of the extract was very close to the recommended time.

Keywords: anesthetics, *Tephrosia purpurea*, induction period, *Poecilloia reticulata*,

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Antiglycation activity, antioxidant activity, total phenol and flavonoid contents of the aqueous extracts of raw and ripe leaves of *Artocarpus heterophyllus*

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There is much interest in plant based medicine with anti-glycation properties. Formation of advanced glycation end products (AGEs) is a major cause of serious chronic diabetic complications. The objective of this study was to analyze protein glycation inhibitory potential on fructose mediated non enzymatic glycation by the aqueous leaf extract of *Artocarpus heterophyllus* (ALEAH) according to a previously published method. 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) scavenging activity, total phenolic and flavonoid contents were also determined. The ALEAH (ripe and raw) was prepared separately according to the preparation of a “Kasaya” in Ayurvedic medicine. The freeze dried powder was used for the investigations. The ALEAH (ripe) at 75, 100, 125 $\mu\text{g ml}^{-1}$ inhibited AGE formation by 52%, 63%, 72% respectively and ALEAH (raw) at same concentrations inhibited 36%, 57%, 63% respectively after two weeks of incubation in the BSA-Fructose assay. DPPH radical scavenging activity at 5, 10, 50, 100, 200 $\mu\text{g ml}^{-1}$ of ALEAH (ripe) was 7%, 13%, 42%, 63%, 66% respectively while the ALEAH (raw) at 5, 10, 50, 100, 200 $\mu\text{g ml}^{-1}$ inhibited 4%, 15%, 27%, 46%, 54% respectively. IC₅₀ value of DPPH assay was 0.11 and 0.16 mg ml^{-1} for ALEAH ripe and raw respectively. Total phenolic content of ALEAH was 53 (ripe) and 38 (raw) mg GAE g^{-1} . Total flavonoid content of ALEAH was 32 (ripe) and 23 (raw) mg QE g^{-1} (QE = Quercetin equivalents, GAE = Gallic acid equivalents). It is significant that ripe (fallen leaves) contained higher activity in every instance than the raw leaves and can be used to combat diabetic complications.

Keywords: Antiglycation activity, *Artocarpus heterophyllus*, radical scavenging activity

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Effects of millet on calcium oxalate crystal growth and dissolution

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The influence of millet on the crystallization and the dissolution of calcium oxalate crystals was investigated in detail under supersaturated and artificial urinary circumstances in order to understand the effect of millet on calcium oxalate kidney stones in humans. The supersaturated solutions were prepared by mixing aqueous solutions of CaCl_2 and $\text{Na}_2\text{C}_2\text{O}_4$. Typical standard reference artificial urine solutions were prepared to simulate the natural urine conditions for the experiments. To investigate the inhibition effect, different volumes of millet were separately added to the supersaturated solutions and artificial urinary solutions and crystal deposition process was monitored by UV-vis and conductivity measurements. The obtained crystals were characterized by FT-IR, SEM, TGA and redox titrations in order to determine the structure and the morphology of calcium oxalate crystals formed. Our findings indicate that the crystals obtained from inhibition and dissolution experiments are of thermodynamically more stable calcium oxalate monohydrate. Furthermore, the results show that the millet has a promising inhibition effect in the supersaturated solution and in artificial urinary circumstances showing 24% and 16% decrease in crystal deposition respectively with 50 mL of millet compared to control experiments. The dissolution effect of millet is far more superior to that of the inhibition effect. One gram of calcium oxalate monohydrate crystals fully dissolved in millet when the crystals were washed ten times with 300 mL millet solutions. Under the same conditions, the control experiment showed only 44% dissolution of calcium oxalate crystals.

Keywords: Calcium oxalate, millet, inhibition and dissolution effect.

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Extraction and acetylation of lignin extracted from rice straw and sugar cane bagasse.

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Rice straw and sugar cane bagasse are waste resources available plentifully in Sri Lanka. In these materials lignin, a phenolic biopolymer is very high. Lignin is considered as one of the most promising renewable resource for the future. Extraction of lignin from waste materials is advantages. Finely ground 80 mesh size raw materials were Soxhlet extracted with toluene: acetone 1:1 (v/v) solvent mixture with biomass to liquid ratio of 1: 8 %wt. at 70 °C for 2 h and impurities such as waxes and silica were removed. Three different chemical protocols were utilized to extract lignin from both rice straw and sugar bagasse viz., (i) alkaline 7.5% (w/v) NaOH (90 °C, 90 min.), (ii) organosolv 85% (v/v) formic and acetic acids at 7:3 (v/v) ratio and (iii) polyethylene glycol: water 80:20 %wt. Wet chemical analysis showed that alkaline process has the highest lignin yield, while organosolv process has the lowest, irrespective of the feedstock. The ash content in rice straw lignin obtained by alkaline process was the highest. By reacting lignin with glacial acetic acid in the presence of pyridine at 90 °C for 60 min. with solvent to lignin 1: 1 %wt. ratio, the hydrophilic hydroxyl groups of lignin were acetylated. This acetylation could widen its eco-friendly applications to be used in various industrial applications with improved physicommechanical properties. Characteristics of raw and modified lignin were compared by several analytical techniques. Effects of the specific functionalization in each case were assessed spectroscopically with Fourier transform infrared (FTIR) and UV-visible spectra. Each of these techniques revealed significant differences in extent of hydroxyl and carbonyl groups exist in both rice straw and sugar cane bagasse lignins obtained by the three different extraction protocols.

Keywords: Lignin, biopolymer, rice straw, sugar cane bagasse, UV-Vis, FTIR

Acknowledgements: *The authors are very much thankful to the Director and staff of Rubber Research Institute, Rathmalana, for their generous assistance in providing FTIR spectra of lignin samples.*

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Comparison of two green methods for refining of crude oil obtained from fish waste of *Lutjanus rivulatus*

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This work was focused to compare two green methods for refining of crude oil obtained by solventless microwave extraction of waste of *Lutjanus rivulatus* followed by filtration. In the first method crude oil was refined by centrifugation (2800 rpm, 10 min.) and in the second method crude oil was treated with bentonite (sieved 250 mesh; 10 % w/w, 20 min) and centrifuged (2800 rpm, 10 min.). Yield, quality and storage stability of the oils were compared. Yields were found to be almost the same (≈ 25.0 %). AOAC and AOCS methods were used to determine density, free fatty acid content, peroxide value, saponification value, iodine value and acid value of the fish oils and, levels were compared with the international fish oil standards (IFOS). Except the peroxide value, other values of both oils agreed with the IFOS recommendations. Peroxide value was satisfied only by the oil obtained by the second method. Oxidative stability of the two fish oils were determined by measuring the change in peroxide value and free fatty acid content. The storage stability in the oil refined by the method two was higher during the studied period. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) levels (%) in the fish oil obtained by the second method (13.8 and 12.2 respectively) were greater than those of by the first method (2.2 and 7.3 respectively). Therefore, the second method where bentonite treated crude oil is centrifuged, is suitable to produce good quality fish oil from *Lutjanus rivulatus* and the oil is also a good source for EPA and DHA.

Keywords: *lutjanus rivulatu*, crude fish oil, refining method, bentonite.

Acknowledgements: *The Authors would like to thank Dr. M.N. Kaumal, Department of Chemistry, University of Colombo, for providing GC–MS facility*

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Physicochemical treatment of synthetic textile wastewater containing reactive black 5

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The colour removal ability of two physicochemical methods, adsorption and Fenton oxidation to decolourize synthetic textile wastewater containing reactive black 5 dye was investigated. Phosphoric acid activated saw dust and rice husk carbon were prepared by using simple methods. Both types of activated carbon showed more than 90% colour reduction at the dosage of 0.1 g of activated carbon per 100 cm³ of wastewater at a 2.5 hour stirring time. Percent colour reduction was increased with increasing the amount of both H₃PO₄ activated saw dust and rice husk carbon and the contact time. Percent colour reduction was increased from 30% to 90% when the adsorbent dosages were increased from 0.025 to 0.1 g. When the H₂O₂ dosage was changed from 0.25 to 2 mM, the percentage colour reduction was increased from 20% to 86% at pH 3 at a constant Fe²⁺ concentration of 0.5 mM. When the Fe²⁺ concentration was changed from 0.01 to 0.1 mM while keeping the H₂O₂ concentration at 2.0 mM, the percentage colour reduction was increased from 17% to 81%. According to the results of this study, both adsorption onto activated carbon and the Fenton oxidation may provide promising solution for the removal of Reactive Black 5 dye from textile effluents economically.

Keywords: Reactive Black 5, adsorption, Fenton oxidation, wastewater

Acknowledgment: Authors thank National Research Council, Sri Lanka for the financial support under the research grant NRC15-155.

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Effect of light and temperature on laboratory assessment of serum bilirubin

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Serum bilirubin measurement is an important diagnostic tool. Bilirubin is a photosensitive molecule making it possible to undergo degradation during the process of laboratory analysis. Objective of this study was to investigate the effect of temperature and light on the stability of serum bilirubin. Serum samples from 34 apparently healthy subjects were used in the study. Bilirubin determination was done by dimethylsulfoxide (DMSO) method using automated Mindray BF 300 analyzer. To determine the effect of temperature serum samples were exposed to -4°C and 33°C for 2 and 24 hours, and to find out the effect of light, serum samples were exposed to sun-light for 6 hours and two CFL bulbs (15 W each) for 24 hours. Data were analyzed using ANOVA followed by *post hoc* Dunnett's test. Though apparently healthy individuals were enrolled in the study, 8 subjects out of 34 were hyperbilirubinaemic. There was a significant reduction in direct, indirect and total bilirubin fractions in the samples exposed to sun-light for 6 hours. Only total and indirect bilirubin fractions had been significantly reduced in the samples exposed to artificial light. The effect was the same in the normobilirubinaemic samples exposed to 33°C for 24 hours but in hyperbilirubinaemic samples all the bilirubin fractions had been reduced significantly. There was no significant reduction in bilirubin where samples were stored at -4°C for 2 and 24 hours, and at 33°C for 2 hours. Therefore, to measure bilirubin, serum samples can be stored at -4°C up to 24 hours and at 33°C up to 2 hours with light protection, without significant reduction in bilirubin concentrations.

Keywords: Direct bilirubin, indirect bilirubin; total bilirubin

Acknowledgements: *We would like to express our sincere thanks to the subjects who participated in the study.*

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Impact of anthropometric measurements on taste perception for sucrose in patients with type II diabetes mellitus

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Obesity is a largely growing health crisis which is strongly associated with diabetes. Taste perception (i.e. preference and supra-threshold intensity ratings) plays a vital role in human life as variations in taste influence food preferences. Even though sugar is essential, excessive intake is a major contributing factor for diabetes. However, the association between anthropometry and the perception of sweet taste in diabetics is inconclusive. Therefore, this study aims to assess the impact of anthropometry on taste perception for sucrose in type 2 diabetics. A sample of 86 diabetics was recruited for the study. Anthropometric measurements were obtained according to Asian standards. Preference for sucrose was assessed by the “Monell 2-series, forced choice method. Supra-threshold intensity ratings for sucrose were tested for a series of sucrose solutions using ‘general Labeled Magnitude Scale’. Preference for sucrose was significantly higher (Men: $p=0.032$ WHtR > 0.5 and Women: $p=0.018$; WC >80) in diabetics exceeding normal anthropometry cut-offs. Men with anthropometry cutoffs above normal showed significantly higher ($p=0.035$ for BMI >23 vs $p=0.009$ for WHR >0.9) supra-threshold intensity ratings for sucrose while women showed significantly lower supra-threshold intensity ratings when their BMI >23 ($p=0.038$), WC >80 ($p=0.014$) and WHR >0.85 ($p=0.007$). In conclusion, irrespective of the gender, preference for sucrose is greater in overweight/obese diabetics. However, the impact of anthropometry on supra-threshold intensity ratings for sucrose was complex with men and women having higher and lower ratings respectively.

Keywords: Anthropometry, diabetes, supra- taste perception threshold, intensity ratings

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Effect of rhythmic Buddhist chanting (*Pirith*) and western pop music on rats' behavioral and hematological responses

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The effect of music on emotional, mental and behavioral changes in humans is well known however little is known about the effects of music on behavior and hematological indices in other animals. The aim of the present study was to investigate the effect of music on rat's behavioral and hematological responses. Two groups of male Wistar albino rats (N = 6/group) were exposed to music; one group to a set of Western pop songs and the other group to *Pirith* (*Thun Sutra*) one hour daily for nine weeks. Another group was kept as the control. Six behavioral patterns (sleeping, grooming, biting paw, scratching, relaxing and balancing) and three hematological parameters (serum total cholesterol, serum glucose and red blood cells count) and pulse rate were observed/measured. The data were analyzed using ANOVA. Mean percentage durations of sleeping and relaxing behavior except grooming behavior were higher in *Pirith* group and were statistically significant ($p \leq 0.05$) between the treatment groups and the control group. Sleeping (57.66 ± 5.63) and relaxing (29.44 ± 4.63) behavior were prominent in the rats exposed to *Pirith* while active behaviors; playing, grooming etc., were observed in the rats exposed to Western pop music. Mean pulse rate between treatment groups (*Pirith* - 340 ± 2.98 ; Western pop music - 410 ± 3.75) and control group (376 ± 3.18) of the experiment was significant ($p \leq 0.05$). According to the results it is possible to conclude that conditioning of rats' sleeping, relaxing and grooming behaviors depend on each sound source. Stressful behaviors were not observed in rats throughout the experiment revealing that *Pirith* and pop music are within the tolerable audible sound range of rats. No significant effects were found on hematological parameters due to music, but further studies on hematological analysis are required to confirm this finding.

Keywords: Audible sound range, *Pirith* chanting, rat behaviour

Acknowledgements: Authors wish to acknowledge Dr. U. A. Jayawardane, Department of Zoology, The Open University of Sri Lanka, Nawala.

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Development and validation of a spectrophotometric method for the analysis of low concentrations of paracetamol in serum

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Paracetamol, has a possibility of causing hepatotoxicity if the recommended dosage (15mg/kg body weight every 6 hours) is exceeded. There is a need for analyzing lower concentrations of serum paracetamol using a less expensive and validated bio-analytical method when over dose of paracetamol use is suspected or for pharmacokinetic studies. The spectrophotometric method established by Glynn and Kendal using nitration of paracetamol followed by absorbance measurement at 430 nm, is validated only for higher concentrations of paracetamol usually observed in acute paracetamol poisoning ranging from 25-400 mg/dm³. In this study, the method was extended to a range of 10-100 mg/dm³ which includes serum paracetamol concentrations at therapeutic doses (5-25mg/dm³). The modified method was validated according to the guidelines on validation of bio-analytical methods introduced by European Medicines Agency. Nine calibration standards were used to develop a calibration curve and the correlation coefficient (R^2) was >0.99. Four quality control standards (QC) (10, 30, 50, 75 mg/dm³- in five replicates) were analysed to determine accuracy and precision. A percentage bias within $\pm 15\%$ of the nominal value was determined as acceptable accuracy. This method demonstrated accuracy within 8% coefficient of variation (CV) of the five replicates within $\pm 15\%$ was considered as acceptable precision. Precision of $< \pm 7\%$ was observed. Stability after one week, bench-top stability and freeze-thaw stability were observed. Accepted percentage bias from the nominal concentration of the QCs to determine stability was $\pm 15\%$, samples demonstrated a percentage bias within $\pm 8\%$. All the criteria required for validation of a bio-analytical method including selectivity, carry-over, linearity, accuracy and precision (within-run and between-run), dilution integrity and stability were fulfilled, and the method was validated for the analysis of serum concentrations of paracetamol.

Keywords: Paracetamol, validation, spectrophotometry

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Induced breeding success and fry rearing of *Mystus Vittatus* (Iri-Ankutta)

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Mystus vittatus (Stripped dwarf catfish), currently listed under ‘least concern’ conservation category in Sri Lanka is a popular food fish species. Yet, present trends of exploitation, aquatic pollution and habitat modification seem to threaten its current status. The objectives of this study were to perform captive breeding of *M. vittatus* under local culture condition, to identify their brood stock requirements, and to study embryonic development and larval rearing of *M. vittatus*. Adult brood stocks were captured from their natural habitats located in Udawalawa, and in “Senananayaka samudra” reservoir in Inginiyagala. Captured adult male and female fishes (n=49) were separated and acclimatized for one month in fiber-glass tanks (dia. 1 m). Three sequential trials were done for induced breeding. In the first trial, fish were injected with Ovulin® (GnRH+Domperidon) 0.5 ml/kg body weight for females and 0.25 ml/kg body weight for males, and were placed in cages built within a tank. There was no successful spawning probably due to disturbances to breeding behavior. In the second trial, same hormone dosage was injected, and fish were kept in a hatchery jar with aquatic plants. Spawning was observed but eggs did not hatch, may be due to mechanical damage caused by heavy water flow in the hatchery jar. In the third trial, after injecting same hormone dosage, fish were kept in fiber-glass tanks (dia. 1 m), consisting of low flow rate, aquatic plants and mud bottom. Successful spawning occurred, eggs were observed and successfully hatched. Embryo and larval development occurred within the first few days. Larval rearing was successfully conducted using live feeds, yet artificial feed was not accepted by the larvae. The present study reveals that *M. vittatus* can be successfully bred in captivity using hormonal stimulation of Ovulin® with 0.5ml/kg body weight for female and 0.2 ml/kg body weight for male.

Keywords: captive breeding, larval development, *Mystus vittatus*, ovulin

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A study on selected characteristics of three age groups of captive elephants in Pinnawala Elephant Orphanage, Sri Lanka

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Pinnawala Elephant Orphanage (PEO) is one of the world recognized Ex-situ conservation center for Asian Elephants (*Elephas maximus*) in Sri Lanka. Present study was conducted from March to September 2017 to collect information on three age groups of captive elephants (n=24), namely calves (n=2) below the age of 6 years and adult females (n=17) and males (n=5) between 06-27 years of age. Relationships between height, weight with the age and gender of elephants, their food preference and the ecto-parasites on their skin were studied. Questionnaire based interviews were conducted with curators and mahouts to record information on diet and specific behavior patterns of the study elephants in PEO. Data on height, weight, age, sex, presence of skin hairs and ecto-parasites were recorded during the study period. According to the findings, height ($P<0.0001$) and weight ($P<0.001$) were positively correlated with the age of elephants. Although there was no significant difference, female elephants of the study group tend to be taller and heavier than the males. Body hairs of study elephants tend to decrease with the age of elephants especially in male elephants when they get old. Their most preferred diet is jaggery palm (42%). An ecto-parasitic insect, *Haematomyzus elephantis* was recorded from all elephants below the age of 10 years (n=4) emphasizing the importance of effective parasitic control programme in captive elephants. Findings of the present study can be used to improve the captive breeding and ex-situ conservation in PEO.

Keywords: *Elephas maximus*, *Haematomyzus elephantis*, Pinnawala Elephant Orphanage

Acknowledgements Head of PEO, the curator of PEO and the supporting staff at PEO are acknowledged.

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Nest characteristics of endemic Dull-blue flycatcher in Horton Plains National Park and surrounding habitats, Sri Lanka

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Nest characteristics of endemic dull-blue flycatcher (*Eumyias sordidus*) were studied at the montane cloud forests of Horton Plains National Park (HPNP) and surrounding habitats from January 2015 to January 2017. Five main habitats were classified as cloud forest, cloud forest die-back, grassland, Eucalyptus plantation and tea plantation. Five quadrats (25m x 25m) were marked in each habitat using a Global Positioning System device. Nest sites were searched on three consecutive days from each month from 06.00h to 18.00h. Pole and mirror method was used to check the nests. Nesting materials were identified by observing adult birds carrying nest materials from the resources during the nest construction period. Nest parameters such as nest cup external diameter, cup internal diameter, the depth of incubation chamber, and total nest length were recorded. A total of 68 nests were recorded during the study period. *E. sordidus* built open cup nest in the cavities of road banks (n=43) and trees (n=25). Mean measurements of the nests were 93.5 ± 14.7 mm for the external diameter, 59.5 ± 10.5 mm for internal diameter, 41.0 ± 9.1 mm for the depth of the incubating chamber, and 90.9 ± 20.1 mm for the total nest length. Nests were mostly composed of *Meteoriopsis sp*, *Thuidium sp*, *Selaginella brachystachya*, *Lycopodiella caroliniana*, *Sinarundinaria densifolia*, *Garnotia exaristata*, *Pteridium aquilinum*, *Eucalyptus sp*, and *Camellia sinensis*. Nesting materials were fixed to the supporting substrate with aid of mud and spider webs. All nest cups were lined with black fern roots and all incubating chambers were facilitated with the smooth scales/ ramenta of *Cyathea crinite*. Therefore, the availability of this unique nest materials may be the most essential factor for nest construction of this endemic species.

Keywords: Sri Lanka Dull-blue flycatcher, endemic, Horton Plains, breeding, tropical montane cloud forest.

Acknowledgements: Financial assistance by University of Sri Jayawardenepura (Grant no-ASP/01/RE/SCI/2016/20).

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Survey on predatory mosquito larvae and their consortium mosquito larvae in selected habitats in Matara district

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Mosquitoes are vectors of life threatening diseases and finding natural control methods is one of the key priorities to reduce the adverse effects of chemical control. A survey was conducted to collect predatory mosquito larvae and their consortium mosquito larvae from eleven locations in Matara district during April to November 2017. Mosquito larval samples were collected once per month and collected 3rd and 4th instar larvae were preserved in 70% alcohol. Mosquito larvae were identified using the standard taxonomic keys. Among the eleven sites, predatory mosquito larvae were identified at three locations, namely Hakgediella (Weligama District Secretariat Division), Gallela (Akuressa DSD), and Kotuwegoda (Matara DSD). According to the survey, *Lutzia fuscans* is the only species found in urban ditches at Kotuwegoda and the other species namely *Lutzia vorex*, *L. tigripes* and *Toxorhynchites* spp. were present in the natural water logging areas at Hakgediella and Gallela. *L. fuscans* larvae live together with *Culex quinquefasciatus* larvae. *C. lophoseromia*, *C. demissus* and *Aedes vittatus* collectively live with *Toxorhynchites* spp. *Anopheles karwari*, *Aedes japonicus*, *Culex parioji*, *Culex barraudus*, *Culex edwardsi*, *Anopheles lindesayi japonicus* and *Culex infantilis* collectively live with the *L. tigripes* and *L. vorex*. Species richness of mosquito species is highest in Hakgedigala and lowest in Kotuwegoda. Permanent rock pools are the best place to the high abundance of the predatory mosquitoes. Potential vector control ability of these predatory mosquitoes needs further investigation.

Keywords: *Lutzia* spp., Predatory mosquitoes, *Toxorhynchites* spp., vector control

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Microhabitat selection by endemic endangered frog, *Fejervarya greenii* (Family: Dicroglossidae) in and around lentic water bodies in a tropical montane cloud forest of Sri Lanka

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The microhabitat selection of endemic endangered frog species, *Fejervarya greenii* was studied in randomly placed plots in and around five lentic water bodies of the Horton Plains National park (HPNP), situated in the highland plateau of the Nuwara Eliya District from January 2016 to December 2016. Sampling was conducted once a month using plot sampling technique. Two plots (10 m x 2 m) each having 20 quadrats (1 m x 1 m) were placed to record habitat variables and to determine the microhabitat selection of *F. greenii*. The quadrat was considered as occupied if at least one *F. greenii* was found within it. Recorded habitat variables were dissolved oxygen, temperature, conductivity and water depth and pH in water, substrate types (submerged plant cover, bare water cover, short plants and shrubs cover, grass cover, decaying plant matter and leaf litter, sand, mud, gravel, rocks), availability of substrates, soil pH, substrate relative moisture, relative humidity, ambient temperature, substrate temperature and body surface temperature. Individual microhabitat variables between occupied and non-occupied quadrates were compared using non-parametric Mann-Whitney U test ($p < 0.05$) since data were not normally distributed. Results revealed that water depth, water temperature, submerged plant cover, decaying plant matter and leaf litter, sand, substrate temperature, relative humidity and substrate relative moisture were the microhabitat variables that influenced microhabitat selection of *F. greenii* ($p < 0.05$). The current study indicates that the conservation and management practices concerning *F. greenii* should include the montane cloud forest habitats of HPNP which provides the optimum conditions for the survival and reproduction of this species in its finest habitat scale.

Keywords: *Fejervarya greenii*, Horton Plains National Park, microhabitat Selection

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A preliminary evaluation of potential predatory activity of *Cyphoderus* spp. (Collembola: Cyphoderidae) on root-knot nematode *Meloidogyne incognita*

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Potential predatory activity of the Collembolan *Cyphoderus* spp. on the infestation of roots by root-knot nematode, *Meloidogyne incognita* was determined experimentally using spinach and tomato plants. Adult Collembolans (n=100) were added to three-week-old plants grown in plastic pots. The plants which did not receive Collembolans served as untreated controls. One week later, all the plants were inoculated with 500 infective juveniles of *M. incognita*. Sixty days after inoculation of nematodes, shoot height and weight, root length, number of galls and egg masses per root system as well as number of Collembolans from 100 cm³ soil was recorded. There were five replications, and the experiments were arranged in complete randomized design in a screen house. Significant increase ($P<0.05$) in shoot height and weight, and root length was detected in both plant species grown with *Cyphoderus* spp. Compared to controls, spinach had 40% while tomato had 37% increase in root length. Number of galls and egg masses per root system was significantly lower ($P<0.05$) in both plant species when grown with *Cyphoderus* spp. compared to controls. Number of *Cyphoderus* spp. recovered from the soil was 27.60 ± 1.50 and 79 ± 5.36 in spinach and tomato respectively. These findings showed that *Cyphoderus* spp. reduced the root infestation caused by *M. incognita* which in turn promoted growth of the plants. The increase in the root length was associated with a reduced gall formation leading to increase in the shoot growth. The reduced infestation by *M. incognita* was most probably due to the predatory activity of *Cyphoderus* spp. on infective juveniles in the soil. Thus, there is a potential to use *Cyphoderus* spp. as a biological control agent in control programs of *M. incognita*.

Keywords: Collembolans, predation, root-knot nematodes

Acknowledgement: RU/SF/RP/2015-03

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Effects of acetaminophen exposure on behaviour, erythrocyte nuclear morphology and gill histology of juvenile *Oreochromis niloticus*: an experimental study

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Environmental presence of human pharmaceuticals remains a concern as it can cause adverse effects on non-target animals. Acetaminophen (APAP or Paracetamol), a common analgesic and antipyretic drug has been found in aquatic ecosystems. The present experimental study followed chronic effects of APAP on behavior, erythrocyte nuclear morphology and gill histology of juvenile tilapia *Oreochromis niloticus*. The experiment consisted of a triplicated control (no APAP) and two exposure groups containing 2 and 10 mg/L APAP in freshwater under static renewal procedure (n= 7x3). The effects were studied after 8-weeks of continuous exposure. Both APAP-exposed groups showed lower (p<0.05) food detection ability, physical avoidance response and mean ventilation rate compared to the fish in the control group, suggesting a possible neurotoxic effect of APAP. Exposed fish also had higher (p<0.05) occurrence of erythrocyte nuclear abnormalities (ENA) compared to those in the control group where the effects on 10 mg/L exposure group were more prominent. Histological alterations were also observed in gills of APAP exposed fish (n=4) showing dilation of secondary lamellae with associated blood congestion, and inter-lamellar hyperplasia. The results revealed that chronic exposure of juvenile tilapia to sub-lethal concentrations of acetaminophen in water caused altered behavior, ENA and pathological changes in gills. It is thus evident that APAP in aquatic environment could be hazardous to non-target animals like fish.

Keywords: Behavioural effects, ENA, environmental pharmaceuticals, genotoxicity, gill histopathology.

Acknowledgement: Authors acknowledge the grant RU/SF/RP/2017/06 from University of Ruhuna for partial funding, Department of Zoology for providing all laboratory facilities, and Department of Fisheries & Aquaculture, Faculty of Fisheries, and Marine Science & Technology for micro-imaging facilities.

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Reproductive performances and condition factor of Rosy Barb, *Pethiya conchoni* (Hamilton, 1822) fed with diets supplemented with medicinal plant materials

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The use of medicinal plants to enhance the reproductive and growth performance is now receiving much attention in the aquaculture industry. Present study ascertained the effects of supplemented diets with three medicinal plants, i.e., *Moringa oleifera*, *Cardiospermum halicacabum* and *Asparagus racemosus* on the reproductive and condition of the Rosy barb, *Pethiya conchoni* (previous name *Puntius conchoni*). Three treatment groups, i.e. T₁ (70% control diet + 30% *M. oleifera*), T₂ (70% control diet + 30% *C. halicacabum*), T₃ (70% control diet + 30% *A. racemosus*), and a control group (diet without medicinal plants) were used each with three replicates, including separate tanks to grow males and females. Eight Rosy barb fingerlings (mean weight, 1.3553 ± 0.4188 g and mean length 3.8190 ± 0.4527 cm) were randomly assigned to each tank, and were fed with the assigned diet *ad-lib* twice a day over a three month period. The length and weight of the fish were measured once in two weeks to calculate the condition factor. Separately, the fish were bred after they reached maturity, and four breeding events were followed. The number of eggs spawned by fish at each event were counted, and fecundity was determined by gravimetric method. The fish fed with *M. oleifera* supplemented diet showed the highest mean fecundity (46.69 ± 7.26) among all groups. Number of eggs spawned per female fish was the highest (65.67 ± 20.69) in T₁ treatment tank and significantly different ($p < 0.05$) from the control while control diet recorded the lowest number (19.50 ± 22.55). Condition factor was significantly different ($p < 0.05$) in fish tested with different diets, having the highest value in T₁ treatment group (2.31 ± 0.47) and the lowest value (1.58 ± 0.46) in T₃ treatment group. It can be concluded that *P. conchoni* fed with *Moringa oleifera* supplemented diet showed comparatively higher fecundity and enhanced condition factor.

Keywords: Condition factor, fecundity, *Puntius conchoni*, spawning

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Comparative analysis of stress, major stressors and coping mechanisms in a selected group of undergraduates of University of Ruhuna

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The stressors related to challenging nature of the university life and the adolescent ages have made the university students much more vulnerable to excessive stress. As such, their academic performance may depend on effective coping mechanisms. Therefore, this study aimed to assess the stress levels, major stressors and coping strategies needed to enhance their academic performances in a selected group of university students. A questionnaire survey was conducted to collect data from Level 1, 2 and 3 students of the Faculty of Science, University of Ruhuna during the 2016/2017 academic year. Total of 165 questionnaires were distributed and 142 valid responses were taken in to consideration. Mean stress levels of male and female students of three study groups were estimated and correlation between the stress level and GPA of study groups were analyzed. Research findings reveal that, though there is no significant difference, female students ($2.83 \pm 0.19\%$) are apparently stressed than male students ($2.65 \pm 0.32\%$). There is no significant difference in the stress experienced by students according to their levels of study however the correlations between GPA and stress level in level 2 ($r= 0.0114$) and level 3 students ($r= 0.4553$) are positive. Most of the students used more than one strategy to cope with the stresses they faced. The most frequent strategy used by the students is sleeping (females 26%, males 24%) and males have more coping strategies ($n=13$) compared to females ($n=10$). Present study indicates that students are having different stress levels throughout their university life. Accordingly, it is recommended to provide specific support and care focused on study level and gender of the students to cope with the university life.

Keywords: coping mechanisms, stress, stressors, undergraduates

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Breeding preference of *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae) in Galle District, Sri Lanka

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Aedes aegypti and *Aedes albopictus* are main vectors of Dengue (DF) and Dengue Haemorrhagic (DHF) Fever in Sri Lanka. Both species are known to breed in microhabitats including water-filled containers, yet whether there is any breeding preference linked to features of containers/ microhabitats has not been addressed. Present study was conducted to find out breeding preference of the two *Aedes* species by estimating relative larval abundance in selected artificial and natural microhabitats. Nine larval surveys were conducted from January to October in 2017, and 1069 containers/ microhabitats were randomly sampled from three localities representing urban (n = 346), suburban (n = 367), and rural areas (n= 356) of Galle District. A total of 552 (51.63%) containers/ microhabitats were positive for both *Ae. aegypti* and *Ae. albopictus* larvae. Both species preferred artificial containers (90.57%) (including rubber tyres: 17.82%, plastic cups: 17.09%, and metal cups: 9.82%) than natural containers (9.43%) (including plant axils, coconut shells and wood caves). Analysis of percentage abundance of larvae revealed that both species had similar preference for black-coloured containers (47.98% for *Ae. aegypti* and 37.32 % for *Ae. albopictus*). Both species were abundant in containers having water level height less than 10 cm (*Ae. aegypti* 77.57% and *Ae. albopictus* 70.11%) and containers with 50-100 ml of water (*Ae. aegypti* 29.28% and *Ae. albopictus* 41.79%). Their abundance increased with the presence of leaf litter in the containers (*Ae. aegypti* 80.69% and *Ae. albopictus* 73.77%). For both species, preferred water temperature was $31 \pm 0.3^{\circ}\text{C}$ (*Ae. aegypti* 58.23% and *Ae. albopictus* 61.21%) while preferred mean water pH was 7.44 ± 0.04 (*Ae. aegypti* 56.84% and *Ae. albopictus* 52.46%). Characteristic features such as the presence of leaf litter, pH and temperature of the logged water within the containers/ microhabitat may play an important role on the abundance of these two *Aedes* vector mosquito species.

Keywords: *Aedes aegypti*, *Aedes albopictus*, breeding containers, larval surveys

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A simple and efficient incremental convex hull algorithm in 3D space

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The convex hull of a set S of points can be defined as the smallest convex set containing all the points in S . The smallest convex set can be identified as the smallest convex polyhedron in three dimensions. There are four existing 3D convex hull algorithms: Naïve, Gift Wrapping, Divide & Conquer, and Incremental with $O(n^3)$, $O(nF)$, $O(n \log n)$, and $O(n^2)$ time complexities respectively where n is the number of points and F is the number of facets of the convex hull. The first three algorithms require the entire set of points at the beginning to process. The incremental algorithm can maintain the convex hull covering the points appearing one by one in space. The existing incremental algorithm is very complicated due to the use of advanced data structures for the implementation. The objective of this work is to propose a new simpler algorithm. The convex hull is represented by a set of triangular facets. If the new point appears inside the existing convex hull then the point is ignored. If the new point appears outside the existing convex hull then some set of facets should be removed from the current convex hull and a new set of facets should be added. If there are n points currently in the space, then there are kn facets in the convex hull where $k \ll n$ in the worst case. It takes $O(kn) = O(n)$ time to test whether the new point is outside each facet. In the worst case, the new point is outside for $(kn - 1)$ facets. Therefore, removing duplicate facets cost $O[\{3(kn - 1)\}^2] = O(n^2)$ time. Thus, the proposed algorithm has $O(n) + O(n^2) = O(n^2)$ time complexity in the worst case.

Keywords: Computational Geometry, Computer Graphics Programming, Coordinate Geometry, Convex Analysis, Linear Programming.

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Comparative study on the buckling properties of Palmyra and Coconut trees

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In this study, a simple device was designed and developed to to measure the critical load to produce buckling of large wooden samples. Using this device, the required critical load to produce buckling was analyzed for Coconut and Palmyra trees. The actual load acting on the selected Coconut trunk was measured as 1059.48 N and the estimated critical load is 1536.72 N. On the other hand, the critical load to bend the Palmyra trunk was determined as 12734.10 N, while the actual load acting on that Palmyra trunk was measured as just 2656.55 N. The ratio between the actual load and critical load for bending in coconut tree is about 1:1.5 while the same ratio is about 1:5 in Palmyra tree. The ratios from the study gives a reason for this observed buckled shape of Coconut tree and Palmyra trees grown in the nature. Further, the same device was used to measure the Young's modulus of the wooden trunks. The average values for the Young's modulus of the selected Coconut and Palmyra trunks were determined as $8.01 \times 10^8 (\pm 2.47 \times 10^8) \text{ Nm}^{-2}$ and $22.16 \times 10^8 (\pm 3.90 \times 10^8) \text{ Nm}^{-2}$ respectively. Highest young's modulus and buckling coefficient of the Palmyra tree made it as the most suitable material for construction work.

Keywords: Critical load, Young's modulus, Buckling nature, Euler's theory

Acknowledgements: I offer my sincerest gratitude to senior lecturer Dr. (Ms) U. Sutharsini and my parents for their encouragements.

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Queueing analysis of patients flow and optimal bed requirement of maternity ward in Matara hospital

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The General hospital Matara is a major healthcare service provider in Matara district. There is some patients' traffic in wards and some patients wait for days until they get a bed. Among these wards in the hospital maternity ward is always riddled with delays. This problem can be managed by using queueing model to determine the waiting line performance such as: arrival rate of expectant women, average service rate of expectant women and system utilization factor in the system.

This research surveys the contributions and applications of Queueing theory in the field of healthcare, examines data from maternity ward in Matara general hospital and uses Queueing analysis to estimate bed unavailability in maternity ward. The data were obtained for all patients in maternity ward over one-month period from July 01, 2016 to July 30, 2016. Queueing system is based on Single-Queue Multiple-Server model. Since arrivals follow a Poisson distribution, service time follows an exponential distribution and patients are served on first come first serve basis, M/M/s queueing model is used to find the optimal bed count. Results of the M/M/s queueing model were used to find the optimal bed requirement of the maternity ward.

Keywords: Queueing model, System utilization factor, arrival rate, service rate, M/M/s.

Acknowledgements: *Our sincere gratitude to all the staff members in maternity ward at Matara General Hospital for their continuous support and advice.*

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Determination of filament temperature of incandescent lamps

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Incandescent lamps are still the most common source of electric lighting in most households. The bulb consists of a tungsten filament placed inside a glass bulb filled by an inert gas. Electric current flows through the filament when the lamp is turned on and this increases the temperature of the filament to about 2500 centigrade. Generally, it is assumed that the electric power supplied to the filament is lost predominantly in the form of radiation although in fact there are three modes of energy loss from a hot body: conduction, convection and radiation. The objective of this study is to investigate the energy loss of bulb filament with input power and to compare it with the theory.

Applied current and voltage data were collected and analyzed for 230V operated, 40W, 60W, 75W, and 100W, incandescent light bulbs. To improve accuracy, resistance of the filament was obtained by fitting the plot of voltage versus current to a function. Filament temperature was determined by using temperature coefficient of tungsten. Generally, the power increases with the temperature of bulbs. It is noticed that the gradient of power versus temperature curve increases the wattage. By fitting power versus filament temperature with $p=aT^b$ function, the selected bulbs were checked whether they follow the Stefan-Boltzmann law or not. The results obtained are satisfactory with the theory. It is observed that as the temperature of the filament increases, the temperature loss by radiation increases faster than that by conduction and convection because of the fourth power of absolute temperature appearing in the law.

Keywords: Incandescent light bulb, Stefan's law of radiation, Heat loss, Temperature dependent resistor

Acknowledgements: *The author would like to thank laboratory staff for providing with lab equipment and arranging lab facilities to conduct the project.*

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Construction of a monochromatic LED replacement lamp

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A lamp was designed and constructed arranging number of coloured LEDs to produce a monochromatic light beam comparable to low pressure Na-lamps with light intensity that are used in physical optics experiments. It comprises compact closed casing with the power wire. The casing comprises square opening (1.5cm x 1cm) in front side to get light beam from the lamp. The power wire is extending 1.2 m with a two pin plug at the end. The power is supplied to the lamp from AC 230V main power. The lamp is compact and smaller in dimensions, 8cm x 6.5 cm x 4cm and is equipped with a hanger to hang it to a required height. Also, it can be kept horizontally on a flat surface. The weight of the lamp is about 300 grams and it produces monochromatic light beam. The intensity of the beam varies with distance away from the source point. The maximum of 140 Lux can be achieved at the source point. The lamp can be used effectively as a substitute for high cost monochromatic Na lamps currently used in optics experiments. In addition to that it is low in cost, consumes less power and is smaller in physical size with compared to conventional Na-lamp.

Keywords: monochromatic led lamp, led lamp

Acknowledgements: *The author would like to thank laboratory staff for providing with lab equipment and arranging lab facilities to conduct the project.*

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Development of a low cost optical spectrometer for visible region

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A low cost modifiable spectrometer was developed for use in the spectral analysis. Light emerging from the source is focused using matching set of lenses on to two adjustable slits to collimate the beam. Then it was directed to the center of a concave mirror. The parallel light beam reflected by the concave mirror was allowed to fall on a 600 lines/mm transmission grating after passing through a wide slit to remove possible higher order Fraunhofer diffraction lines. The dispersed light beam was directed through a converging lens before it was detected by a linear photodiode sensor array to ensure a maximum collection of light falls on the detector. The linear photodiode sensor TSL1406R was interfaced to Arduino platform. A software application was developed to display a plot of Intensity versus corresponding pixel number on the computer screen while saving data to a text file. Standard light sources of Cadmium, Mercury, Sodium, and laser light were used to calibrate the spectrometer. After the calibration, a light spectrum from a Compact Florescent Lamp (CFL) was analyzed and found that the emission lines of the spectrum are in good agreement with their standard values up to a nanometer. Working spectral range is 398~755 nm and the observed spectral resolution for two neighboring CFL lines is 3.8 nm. The signal to noise ratio is about 30.2 for the laser peaked at 660.79 nm and the total construction cost is approximately Rs.12000 for the spectrometer.

Keywords: spectrometer, Arduino, grating, and photodiode

Acknowledgements: *Support provided by the Department of Physics, University of Ruhuna is acknowledged.*

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The momentum distribution of one-dimensional strongly repulsive Bose gas at large momenta

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The physics of ultracold Bose gases is a rapidly developing field due to the recent remarkable achievement in the experiment and intensive theoretical investigations. However, when understanding quantum correlations, the calculation of correlation functions of such many-body systems always imposes a big challenge. In this communication, we analytically calculate the momentum distribution of the one-dimensional Bose gas at high momenta through the Fourier transform of the single-particle density matrix. Using the Bethe ansatz wave function of the one-dimensional strongly interacting bosons at the ground state, we find that asymptotic behavior of the momentum distribution for large values of momenta obeys the universal power law C/p^4 decay, where the Tan's contact C can be given explicitly in terms of the generalized exclusion statistics parameter.

Keywords: Bose gas, Momentum distribution, Tan contact.

Acknowledgements: *This work has been supported by CAS_TWAS President's Fellowship for International PhD student.*

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Detecting and correcting real-word errors in Tamil sentences

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The spell checker concerns the two types of errors namely *non-word errors* and *real-word errors*. Non-word errors can be of two categories. First one is that the word itself is invalid. The other is that the word is valid but not present in a valid lexicon. Real-word error means the word is valid but inappropriate in the context of the sentence. An approach to correcting real-word errors in Tamil language is proposed in this paper. A *bigram probability model* is constructed to determine appropriateness of the valid word in the context of the sentence using a 3GB volume of corpora of Tamil text. In case of lacking appropriateness, the word is marked as a real-word error and *minimum edit distance* technique is used to find lexically similar words, and the appropriateness of such words is measured by a *word-level bigram language probability model*. A hash table with word-length as the key is used to speed up the search for words to check for the lexical similarity. Words of lengths of $m-1$ to $m+1$ are considered with m being the length of the word found to be 'inappropriate'. Finally, top five words are selected as suggestion for correction. Test results show that the suggestions generated by the system are with 98% accuracy as approved by a Scholar in Tamil.

This technique may be used to check real word errors in other languages too with sufficient corpus to build the bigram probability model for the language.

Keywords: Tamil, Real-word error, Bigram, Minimum edit distance, Error correction

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Development of a green building rating tool for special nature buildings (hotels) in Sri Lanka

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Increased importance on the green building concept lead to introduce an assessment tool called rating system to be used for evaluating the building performance under sustainable framework. Separate rating tools are important to assess different types of building to maintain the sustainability while fulfil their special requirements. The main objective of the present research was to develop criteria and indicators to formulate a new rating tool for special nature building type which has shown an increasing attention to develop a separate rating tool in Sri Lanka. The study was undertaken with the comparison of LEED, Green building index, Green mark and Indian rating tools for identifying the building types which possess separate rating tools.

The research was conducted based on primary and secondary data. The selected building type was 'hotels' which has a high demand to develop a new rating tool in Sri Lanka. Eight main criteria were identified together with seventy indicators. Criteria were weighted by using a survey. The responses were obtained from hotel management staff and green building professionals. The point allocation from the highest to the lowest as follows: energy efficiency (22), water efficiency (20), occupant health and comfort (15), material and resource selection (12), sustainable site planning and management (10), waste management (8), innovation and cost reduction (8) and social and cultural identity (5). Maximum point allocation was 100 and overall ratings were designated as follows: certified 40–49 points, silver 50–59 points, gold 60–69 points and platinum 70 points and above.

Keywords: Energy efficiency, green building rating system, occupant health and comfort, sustainable dimensions.

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Effect of Sound on the *Staphylococcus Aureus* bacterium

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With the rapid urbanization, the major environmental effect is increasing the microbial infections through water. Therefore, it is important to investigate a method of controlling these harmful bacteria in an ecofriendly, cost effective, simple and accurate way. This investigation totally focuses on distortion of *Staphylococcus Aureus* bacterium in a water sample through the sound treatment method. As the first step, a sample of *Staphylococcus Aureus* bacterium was sub cultured in the nutrient media and one portion of the above sample was used for experiment while other part was considered as the reference sample. The piezo tweeter along with the functional generator was used to create sound waves. The bacteria samples were exposed mainly into two frequency ranges called Acoustic frequency and Ultrasound frequency throughout two hours per each frequency range in a silent room. The treated samples were cultured using the nutrient agar media. The number of the colonies of treated sample and reference sample were compared, and positive sound effect was observed. Furthermore, it reveals that ultrasound is more effective than acoustic sound to destroy the *Staphylococcus Aureus* bacterium in a water sample. It can be interpreted in numerical values as 33% of colonies in the acoustic sound treated sample have been reduced than the reference sample and also 50 % of colonies in the ultra sound treated sample have been reduced than the reference sample. According to these results, it states that the sound waves have an ability to destroy the *Staphylococcus Aureus* bacterium in a water sample.

Keywords: Acoustic frequency, Contaminations, Culture, Nutrient agar, Ultrasound

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Synthesis and characterization of bacteria-mediated silver nanoparticles

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Various organisms including plants and microorganisms can produce metal nanoparticles (NPs) intra- or extracellularly. Silver nanoparticles (AgNPs) were synthesized from *Pseudomonas aeruginosa* (ATCC 27853), *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922) and *Acinetobacter baumannii* (confirmed clinical isolate) in an eco-friendly and less toxic approach. Bacteria were cultured in nutrient broth medium. After 72 h of incubation, 1M AgNO₃ solution was added into cell free filtrates. The culture conditions (AgNO₃ concentration, pH, temperature, incubation time) were optimized to produce a maximum yield. Biosynthesized AgNPs were purified using ultracentrifugation followed by freeze drying. The characterization of synthesized NPs was performed using UV-Visible Spectroscopy, Fourier Transform-Infra Red Spectroscopy (FT-IR), X-ray Diffraction spectroscopy (XRD) and Transmission Electron Microscopy (TEM). In UV-Visible spectra, characteristic peaks around 425-433 nm were observed in all four biosynthesized AgNPs. This is found to be the first report on AgNP synthesis by *A. baumannii*. All biosynthesized AgNPs were spherical. The average sizes of the NPs were 11.14 ± 6.59 nm (*S. aureus* NPs), 11.71 ± 2.73 nm (*P. aeruginosa* NPs), 12.87 ± 2.95 nm (*E. coli* NPs) and 12.22 ± 2.45 nm (*A. baumannii* NPs). In FT-IR spectra, interaction between AgNPs and media components such as proteins and polymeric compounds was evident (bands at 2924 cm⁻¹, 2916 cm⁻¹ and 1643 cm⁻¹, etc). According to XRD patterns of the AgNPs, characteristic diffraction peaks were obtained confirming crystalline structure of AgNPs. These results show that the bacteria mediated AgNP synthesis was successful, producing smaller AgNPs (< 20 nm) with a narrow size distribution.

Keywords: Silver nanoparticles, TEM, UV-Visible spectroscopy

Acknowledgement: We wish to acknowledge the University of Sri Jayewardenepura for providing financial support and laboratory facilities (University Grant No: ASP/01/RE/MED/2016/42).

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Approximate solutions of time fractional Fornberg-Whitham type equations by Laplace decomposition method

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In this study, the approximate solutions of the nonlinear time fractional Fornberg-Whitham and modified Fornberg-Whitham equations are derived by means of the Laplace decomposition method. Laplace decomposition method is a combined form of the Laplace transform and the Adomian decomposition method. The obtained solutions are compared with the exact solution to verify the accuracy of the method. Further, the numerical results showed that the behavior of the approximate solutions is similar to the behavior of the exact solutions. Consequently, we realize that the approximate solution is rapidly convergent series as the exact solutions. In addition, the computations shows that the described method is easy to apply and it has a small cost of computation.

Keywords: Fractional derivative; Time-fractional Fornberg-Whitham equation; Adomian decomposition method; Laplace Transformation.

Acknowledgement: *Authors would like to acknowledge the Department of Mathematics and Statistics, University of Jaffna, Sri Lanka for providing all facilities to do this research work.*

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Design and analysis of a phase difference measurement system with improved performance.

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The accuracy or error of a phase difference measurement between two different sinusoidal signals is significantly affected by the noise in them. Quadrature Demodulation (QD) is one of the methods used for calculating the phase difference under considerable noise levels especially in discrete-time measurement systems. Even though the accuracy of the usual QD method may be sufficient enough for some environments, in conditions that involve noise levels that is reasonably larger, higher accuracy is much desirable. In this paper, an improved QD method to decrease the phase error and thus increase the accuracy of a phase difference measurement is proposed and established. The increased accuracy of the measurements are confirmed by experimental methods using input signals of signal-to-noise ratios (SNRs) ranging from 6.00 dB to 30.0 dB. When compared with the usual QD method, the experimental results for the phase error measurements have proven that under similar time consumptions, the proposed method is more accurate by a factor of greater than 2 to 4. Even at the worst SNR level at 6.00 dB the proposed method is more accurate by a factor of greater than 2 and the phase error is no more than 0.1° for 100 single averaged measurements of the phase differences. At higher SNR levels the accuracy of proposed method further increased up to a factor of 4.4. The proposed method could be used in discrete-time phase measurement systems with a higher accuracy.

Keywords: Phase difference, Noise, Accuracy, Error

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Trends and effect of economic factors of suicides in Sri Lanka

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The effects of ten socio economic factors on suicides of Sri Lanka are investigated using multiple regression analysis on time series data from 1975 to 2015. This study also includes a graphical analysis of trends of suicides in relation to several factors. Graphical and tabular analyses reveal that the overall rates of suicide has noted peak in 1995. Throughout the entire period male suicides are higher than female suicides. It is observed that there is an upward trend in suicides over the years and a downward trend in suicides over the age groups in both overall and male suicide categories. This is statistically tested by using simultaneous homogeneity against ordered test which involves the calculations of isotonic regression. The study reveals that married persons among civil status, Tamil's among ethnic groups, and also rural agricultural districts obtained highest suicide rates. The multiple regression analysis reveals that the variables persons aged 65 and above, persons elder dependent, person younger dependent and female labour force participation are statistically significant in both male and female suicide mortality. Also the unemployment is significantly related to young and middle aged suicides, population of child-aged is related to all middle-aged and elderly-aged suicides and young-aged female suicides, population of old-aged is related to middle aged female suicides, population density and GDP growth rate are related to young-aged male suicides, inflation is related to middle-aged and elderly-aged male suicides, young age dependency is related to middle aged-male suicides, Birth rate is related to middle-aged female suicides.

Keywords: suicide rate, economic variables, multivariate regression analysis, isotonic regression

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Numerical solutions of a time fractional reaction-diffusion model for pattern formation in coral reefs

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In this paper, we propose a Time Fractional Reaction-Diffusion model for the growth of corals in a tank and solve that model numerically. In order to do numerical simulations, we transformed the model equations in to a system of ordinary differential equations (ODEs) by discretising the model equations in space and represented it in a matrix form. Also, we represented the discrete Laplace operator of the model by a matrix embedding of the boundary conditions. We solved this system of ODEs using an explicit scheme, two implicit schemes and Matlab code FDE12 written by R. Garrappa which is an implementation of the predictor-corrector method. We compared the solutions obtained by these numerical methods.

Keywords: Fractional ODEs, Time Fractional-Reaction-Diffusion Equations, Patterns formations, Caputo Fractional-Order Derivative

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Hearing threshold shift of workers in metal quarries and crushers due to high occupational noise exposure

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Occupational noise causes both auditory and non-auditory health effects. This study is focused on the variation of hearing threshold level of a sample of workers as Metal Crushers (MC) and Metal Quarries (MQ) at eleven sites in Southern Province of Sri Lanka. The selected sample excludes workers with any previous hearing problems. MC and MQ were categorized in to five groups of operators of *Hammer, Metal breaker & Bucket, Crusher, Asphalt plant and Machines*. A-weighted continuous sound level (L_{Aeq}) at the work place was measured at frequencies 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz and 8 kHz ($1/3^{rd}$ octave band) using Bruel & Kjaer (B&K) hand held analyser Type-2250. An audiometric hearing test was conducted as guided by American National Standard Institute (ANSI) S3.1-1991 using Amplaid 321 audiometer with the assistance of an Audiologist. A total of 84 workers participated in the study. Hearing threshold shifts of both air conduction (AC) and bone conduction (BC) measurements were significantly higher at all frequencies studied. Both inner and outer ears of workers were affected. Larger hearing threshold shifts were seen in the AC measurements of operators of Hammer, Metal Breaker and Crusher at frequencies greater than 2 kHz. High level of occupational noise, $L_{Aeq} > 85$ dB at many sites, is the cause for the high threshold shift. Although, only four hours are allowed to work at high noise level machines, most of them are working at the site throughout the day. This study indicates that some mitigation actions have to be taken to avoid the hearing loss of workers at the sites studied.

Keywords: L_{Aeq} , Noise exposure, Audiometric test, Hearing threshold shift, Air and Bone Conduction.

Acknowledgment: *Authors acknowledge the financial assistance provided by the TURIS Project under Grant No: RU/DVC/Pro 61*

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Stability analysis of a double delayed HIV– I dynamics model with nonlinear functional response and absorption effect

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Several models for the HIV–I have been constructed with the assumptions that the processes within the body compartments are instantaneous, the incidence rates of the activities between viruses and target cells are bilinear and when pathogens are absorbed into susceptible cells, the number of pathogens is not reduced in the blood volume. Biologically, instantaneous processes, nonlinear incidence rates, and the absorption effect inside the body have been proven.

Thus, in the proposed mathematical model, stability properties of HIV- I dynamics model including a Beddington – DeAngelis type functional response, an intracellular time delay, a maturation time delay, and an absorption effect are investigated. The intracellular time delay can be identified as the period of time between entry of the virus into a susceptible target cell and the production of new virus and the maturation time delay can be recognized as the time period which is taken by a virus to grow after the infected cells create the virus. By analyzing the characteristic equations of the model, the local stability behaviors of the infection free equilibrium (E_0) and the chronic infection equilibrium (E^*) are established. The mathematical analysis shows that the stability properties are entirely determined by the basic reproduction number (R_0) of the model. By means of Ruth Hurwitz stability criterion, it is proven that the infection free equilibrium is locally asymptotically stable when $R_0 \leq 1$, and the chronic infection equilibrium is locally asymptotically when $R_0 > 1$. Moreover, the numerical simulations are also demonstrated in order to validate the theoretical results. These results will lead to give more important recommendations to the drug producers to upgrade the existing drugs.

Keywords: Absorption Effect, HIV- I infection model, Intracellular Delay, Local Stability, Maturation Delay

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Identification of Gender from Acoustic characteristics of Sinhala vowels

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Speech is a pressure wave generated in air. When air is pushed through the vocal folds with sufficient pressure, the vocal fold vibrates and produces voice with the help of articulators. Inside the vocal tract, air is resonated, and these resonances are known as formants in acoustic phonetic. Formant is the most significant parameter used in speech sound analysis. Speech acoustic characteristics are not only different from person to person but also from language to language. In this study, formant analysis of Sinhala vowel sounds is done to investigate the correlation between speaker gender and acoustic characteristics. Randomly selected 66 native Sinhala speakers of 31 males and 35 females of age range between 19 to 36 years were used in the study. Twelve Sinhala vowels were used as the speech material. Audio files were recorded by using a smart phone having a sampling rate of 44 kHz in a quiet room (25 dB). Recorded MPEG 1 Audio Layer III files were converted to wave files and fed to *Praat* software. The first three formants, f_1 , f_2 and f_3 the most stable in each vowel were determined by analyzing the respective spectrograms. R and SPSS software were used for statistical analysis. The estimated discriminant equation of f_1 and f_2 is $f_2 = -1.36f_1 + 2486.36$. The statistical measures of the performance of a binary classification, the hit ratio, sensitivity and specificity were 90.8%, 96.6% and 86.1% respectively. This strong separation justify that the gender parameter is grouped with the f_1 and f_2 variables. Therefore, formant analysis can be used to predict the gender of an unknown speaker, even for telephone conversations.

Keywords: Acoustic Characteristics, Discriminant Analysis, Formants, Gender, Sinhala vowel

Acknowledgement: Authors acknowledge the financial assistance provided by the UGC block grant No: RU/PG-R/16/12.

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Forecasting monthly cinnamon prices in Matara District using ARIMA approach

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Cinnamon is one of the most valuable crops in Sri Lanka. The global market attracted a lot of attention for the Ceylon Cinnamon. This study was focused on modelling M-5 type cinnamon prices in Matara district in Sri Lanka using Time Series Analysis and identifying the best fitting statistical model for the objective to forecast cinnamon prices. Monthly average cinnamon prices (in Rs/kg) data from 2006 to 2016 were collected from Department of Export Agriculture, Sri Lanka. Various Box – Jenkins time series models were fitted on this data using Eview software. The ARIMA (0, 1, 1) model was found to be the best model for cinnamon prices based on the results of Dickey Fuller test, three criteria (Akaike info criterion, Schwarz criterion and Hannan-Quinn criterion) and residual analysis. The model was trained using January 2006 to April 2015 and validated using May 2015 to May 2016. All the predictions are made assuming that the prevailing conditions in the country affecting Cinnamon prices remain unchanged during the period.

Keywords: Cinnamon prices, ARIMA Model, Time Series Analysis

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Heteroatom rich mesoporous carbon supported gold nanoparticles – An efficient catalyst for benzyl alcohol oxidation

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Oxygen and nitrogen rich hierarchically porous carbons (NC/O and NC/O,N respectively) were synthesized by using furfuryl alcohol and furfuryl amine respectively as the carbon precursors by nanocasting into hierarchically porous SiO₂ monolith templates. Gold nanoparticles (Au NPs) on porous carbon were synthesized by incipient wetness followed by reduction of chloroauric acid. The resulting supported catalysts were characterized by transmission electron microscopy (TEM), scanning electron microscopy (SEM), X-ray diffraction (XRD), X-ray photoelectron microscopy (XPS), Raman spectroscopy and N₂ sorption. The macroporous structure was successfully replicated in the carbon monoliths, while the mesopore structure was inverted giving high surface area and mesopore volume. From TEM the average nanoparticle size of the Au NPs was found to be 39 nm for NC/O and 25 nm on NC/O,N. SEM showed that the nanoparticles (NPs) were heterogeneously distributed on the carbon support. Au NPs were found to be metallic from the XRD patterns with metallic surface as indicated by XPS. Raman spectra indicated the presence of amorphous carbon and a new type of disorder could be seen in NC/O,N as revealed by the shift in D band frequency in NC/O,N. The Au NPs incorporated NC/O and NC/O,N are efficient catalysts for benzyl alcohol oxidation.

Keywords: heteroatom, carbon support, porous, gold nanoparticles, catalysis

Acknowledgments: Authors acknowledge G. Szulczewski, Paulo T. Araujo, K. Shaughnessy, C.J. Cassady, and J. Allred for their valuable discussions.

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Integrating IoT with greenhouse environments for monitoring and analysis

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The increasing demand for quality crop production has significantly risen in utilization of high quality greenhouses. Specific environmental conditions are required to cultivate crops in greenhouses. Monitoring environment parameters such as humidity, soil moisture, and light play a significant role in research that attempt in optimizing efficiency in greenhouse crop production. Automated monitoring of above parameters plays a vital role in researches which are carried out under the greenhouse conditions in Sri Lanka. Currently researchers visit greenhouse and use complex instruments to monitor these conditions. In this study, it is expected to enhance the system automated way with creating an advance dynamic network of Internet of Things (IoT). This study is designed and developed a sensor based android mobile application that facilitates transition data to IoT web server over Wi-Fi connection while enabling view information efficiently through the mobile application. Main users of this application (e.g. researchers) can collect real time data that monitor greenhouse conditions, receive notifications, input plant performance details, study and control parameters using graphs. Proposed approach focuses on development and integration of four main modules: Wi-Fi sensor device, IoT Server, Firebase database and mobile application. The device is designed by integrating DHT11 (Humidity and Temperature sensor), LDR (Light intensity sensor) and Arduino Soil moisture sensor. Collected data can be analyzed with respect to controlled factors and the time. It provides three graphs in order to show basic measures of plant growth performance including shoot length, shoot diameter and number of leaves. Therefore, on the basis of these graphs, researchers are able to analyze plant growth during the specified time period. Further, this analysis can be used for future predictions and decision making for large collection of data. Developed Android application was tested on the selected mobile platforms using questionnaires. We received feedback from participants to the system and their outcomes were: the accuracy of measured values for tested parameters and ability to maintain plant log for treatment were high; the usability and readability of the system was in an acceptable level.

Keywords: iot, mobile applications, wi-fi sensor, greenhouse

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Some estimations of summation-integral-type operators

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In this paper, we study about the Szász-Mirakjan- Kantorovich type operators and obtain the rate of convergence in the sense of local approximation results with the help of modulus of smoothness, second order modulus of continuity, Peetre's K-functional and functions belonging to the Lipschitz class. For computing the order of approximation of the operators, we discuss the weighted approximation properties by using weighted modulus of continuity and prove the theorem.

Keywords: The Szász-Mirakjan operators, the Kantorovich operators, the Korovkin-type approximation results, modulus of smoothness, Peetre's K-functional, weighted modulus of continuity

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Use of dynamic text prediction for Tamil text editing

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In text processing, typing whole documents by ourselves leads to lots of spelling mistakes and also it is time-consuming. When it comes to morphologically rich languages like Tamil language, it's even more difficult, due to the absence of a clear picture of the Tamil keyboard layout. The aim of this research study is to develop a user-friendly tool to perform next word prediction and spell checking. In our approach, while user types, we detect the user's typing domain using a classifier and then predict the next word according to the predicted domain. Next word prediction is done using domain-specific language models by giving priority to trigram and then bigram. Language models can continuously learn from user's typing. Recency-based model is used to reduce the search space. Also, detect misspelt words and propose dictionary lookup with distance measure and improve the dictionary suggestion list using n-grams lookups. According to our experiments, Tamil language results in lowest word prediction percentage (WPP) accuracy among Sinhala and English languages. We further analyzed results by varying the total number of words in all three languages and counted the number of unique words. It can be seen from the results that Tamil language has the highest unique words compared with the other two. Tamil language has a large vocabulary than the other two languages and we believe that the lowest prediction level was obtained due to this diversity. Dynamic prediction helps the users, because within a document, we may need different domain n-gram models to predict words. Dictionary lookup with forward and backward bigrams show highest improved accuracy, of 54% while dictionary lookup achieved 36% accuracy.

Keywords: Tamil language, dynamic word prediction, language models, spell checker

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Methods to measure value at risk of a portfolio: a case study on Sri Lanka Stock Exchange

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In this study three different methods are used to measure and compare Value at Risk (VaR) of four different portfolios. Twenty securities which are used to calculate S&P 20 SL index in Colombo Stock Exchange were used to construct four different portfolios each worth Rs.100,000. Data was obtained from Colombo Stock Exchange during the period of 1st of January 2012 to 30th of September 2016. Four portfolios were constructed using the securities with the mean closing prices: less than Rs.100, Rs.100 - Rs.200, Rs.200 - Rs.300 and greater than Rs.300. Equally weighted VaR models were constructed for selected portfolio securities. VaR is calculated using three different methods namely Variance-Covariance method, Historical method and Monte-Carlo Simulation method at three different significant levels. When making decisions about a portfolio it is best to make decisions by considering the maximum loss that can be expected when investing in a particular portfolio. By comparing the values obtained in different portfolios the study concluded that, if the VaR is calculated at 90% or 95% of confidence, the best method is Monte Carlo method while if the VaR is calculated at 99% of confidence, the best method is Historical method. Further it could be seen that the portfolio that constructed using the securities with mean closing prices Rs.100-Rs.200 gives the lowest VaR value and the portfolio that is constructed using the securities with mean closing prices above Rs.300 gives the highest VaR value from all three methods.

Keywords: value at risk, variance covariance method, historical method, monte-carlo simulation method

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Improving user friendliness of Singlish to Sinhala Unicode converters by word prediction

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Singlish is a method that uses Latin characters (English) for transcribing Sinhala words. Sri Lankan people are more familiar with this method of input than typing with the standard Sinhala keyboard layout (Wijesekara keyboard). There are some software applications to convert such Singlish text into Sinhala Unicode text. In such converters, there is an underlying Transliteration Scheme, where one or more English characters correspond to a single Sinhala character. So, the user interacting with the converter has to remember this transliteration schema when typing. Our main objective is to introduce a method to reduce the need of a user remembering a transliteration scheme and to save keystrokes in typing. In this paper, we propose a method to provide meaningful Sinhala word predictions for the Singlish words typed by the user. This method includes current word and next word prediction. For developing this, we used Ngram models and string based pattern matching. Also, we analyzed the impact of limiting those two ways of predictions to the user's intended domain. Our evaluation results show that our approach can reduce the number of keystrokes required in typing. Also, limiting the word predictions to the user's intended domain further reduces the number of keystrokes. From this kind of a keystroke reduction, the user-friendliness of the input system can be improved.

Keywords: singlish, sinhala unicode, unicode converters, word prediction

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Sinhala news analysis using text mining and machine learning

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Due to the rapid development of information technology, vast amounts of information are generated daily. Unstructured data such as news reports are a significant part of these growing information repositories. This study focuses on analyzing Sinhala news reports published online to extract important features using text mining and machine learning techniques. Then, represent this extracted information in a way that news readers find it easy to read news or do research on past news reports. For a morphologically rich complex language like Sinhala, it makes text mining a difficult task.

In our approach, we first pre-processed dataset with filtering, stop word removal, stemming and then experimented with feature selection methods such as n-gram combinations, count vectorizer and TF-IDF vectorizer. Text classification methods such as Naïve Bayes, Support Vector Machines, Decision Trees, K-means and hierarchical clustering methods were evaluated. Later, we represented the mined knowledge using information visualization methods such as charts, tag clouds and tree structures.

Unigram features with TF-IDF vectorizer for feature selection, Naïve Bayes for document classification and K-means for clustering were the most accurate techniques for Sinhala news. The accuracy of the information visualization methods was measured with human experts. Our results reveal that language specific text pre-processing and feature selection increases the efficiency of information retrieval tasks when compared to generally used existing methods and the new representation model saves users' time and effort to find news reports based on their preferences rather than going through existing news websites.

Keywords: Sinhala language, feature selection, text classification, text clustering, information visualization

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Preliminary results of Low Resolution Spectroscopy of some selected stellar objects using a DSLR camera

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Properties of distant stars and galaxies such as their chemical composition, temperature, density, mass, distance, luminosity, and relative motion using Doppler shift measurements can be studied using their spectroscopy. Spectra of some selected stellar objects were obtained utilizing a grating and a Digital Single Lens-Reflex (DSLR) camera in this research. Canon EOS 6D DSLR camera with a telephoto lens was used as the recording device and 300 lines per millimeter grating mounted in front of the lens was used to generate the spectra. Spectra of planets Jupiter, Mars and stars Betelgeuse and Vega were photographed. Star Vega which is a type A star was used as the reference to calibrate the spectra of the other stellar objects. A software package IRIS was used to reduce the obtained images and the reduced images were analyzed using a spectrum analyzing software VisualSpec (Vspec). Characteristics of the obtained spectra were compared with the standard spectra. Results were obtained using an analysis of low resolution spectra and the Hydrogen absorption lines, H_{α} , H_{β} , H_{γ} and H_{δ} were identified in the study.

Keywords: DSLR camera, Grating, IRIS, Vspec

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Plant regeneration from cotyledonary nodal explants of tomato (*Lycopersicon esculentum* Mill.) cultivar KC-1

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This experiment was carried to study the *in vitro* shoot response of cotyledonary nodal explants derived from 12 days old *in vitro* grown seedlings of tomato cultivar KC-1. A centimeter long cotyledonary nodal explants were excised carefully from *in vitro* raised seedlings and cultured on MS media with 0.5-1.0 mg/l kinetin and 1.0-0.5 mg/l IAA or with 0.2-1.0 mg/l BAP and 1.0-0.2 mg/l NAA. After 4 weeks of culture, they were sub-cultured on MS medium containing 2.0 mg/l BAP and 0.2 mg/l NAA. The results revealed that the morphogenetic response percentage of the cultured explants on the different media ranged from 62.5% to 79.2%. Microshoots initiated after 10 days of culture showed significant variation ($P < 0.001$) on number of microshoots per explant at 4th week of culture. Maximum number (3.0) of microshoots per explant was obtained directly from the explants when BAP (1.0 mg/l) was used in combination with NAA (0.2 mg/l). Root initiation from the explants was noted after 14 days of inoculation. Hairy roots were also formed on the explants cultured in all culture media but MS medium supplemented with 0.5 mg/l kinetin and 1.0 mg/l IAA gave higher number of hairy roots. MS medium supplemented with 1.0 mg/l BAP and 0.2 mg/l NAA exhibited better *in vitro* shoot initiation over MS medium containing kinetin and IAA. After 4 weeks of culture, microshoots were transferred to 2.0 mg/l BAP and 0.2 mg/l NAA medium for shoot elongation and root formation. Developed plantlets were then acclimatized after 8 weeks of culture. It could be concluded that BAP and NAA combination was best for clonal propagation directly from cotyledonary nodal explants of tomato cultivar KC-1.

Keywords: BAP, microshoots, NAA, nodal explants, tomato cultivar KC-1

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Identification of genes encoding heavy metal transporting proteins in selected bacteria of an effluent

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Characterizing microbial genes that encode proteins involved in heavy metal tolerance is useful for bioremediation. The genes *czcD* and *zntA* (948 bp and 2448bp) encode proteins reported to be involved in transporting heavy metals from cytoplasm to periplasm in bacteria. In this study, extracted genomic DNA of strains of *Staphylococcus epidermidis* (O5, O6, O7, O8, O9, O10, D7), *Staphylococcus warneri* (G, Ow) and *Aeromonas jandaei* (O3), isolated from an industrial effluent in Sri Lanka, were used to amplify partial *czcD* and *zntA* genes by polymerase chain reactions (PCR). Three different primer sets were designed for the amplification of *czcD* gene of *S. epidermidis* and *S. warneri* and *zntA* gene of *A. jandaei*. Genomic DNA was isolated using a modified guanidium thiocyanate method. In PCR, a fragment of 672 bp was obtained for all strains of *S. epidermidis* except strain D7, at an annealing temperature of 54 °C and a fragment of 794 bp was obtained for Ow strain of *S. warneri* at an annealing temperature of 53 °C. In analysis through Bioedit software, amino acid sequences of amplified fragments were 100% similar to amino acid sequence encoded by partial *czcD* genes of *S. epidermidis* (Accession Number: NC_004461) and *S. warneri* (Accession Number: NC_020164) respectively. A fragment of 647 bp was obtained for PCR that carried out for O3 strain of *A. jandaei* at an annealing temperature of 57 °C. Amino acid sequence of the amplified fragment showed 98% identity to Zn, Cd, Hg and Pb transporting ATPase protein in *A. jandaei* in BLAST search compared to the ZntA. Presence of *czcD* gene in *Staphylococcus* sp. and Zn, Cd, Hg, Pb transporting ATPase gene in *Aeromonas* sp. were confirmed.

Keywords: Bioremediation, *Staphylococcus*, *Aeromonas*, *czcD*, *zntA*

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Preliminary stem anatomy of the genus *Cinnamomum* found in Sri Lanka

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Anatomical characters of the stem of Sri Lankan species of *Cinnamomum* (*C. capparucoronae*, *C. citriodorum*, *C. dubium*, *C. litsiaefolium*, *C. ovalifolium*, *C. rivulorum*, *C. sinharajensis* and *C. verum*) were examined for taxonomic purpose and as an objective to fill the anatomy data gap of *Cinnamomum* species. Stem parts collected from three individuals of each species from Cinnamon research center, Matara, were hand sectioned, fixed, stained and observed under light microscope. Shape of the stem of *C. litsiaefolium* is oval while all other species were round in shape. Rectangular shaped vascular bundle was found in *C. litsiaefolium* whereas rest of the species had round shaped vascular bundles with circular arrangement. Sclerides were observed in the pith in different shapes and frequencies. Round shaped sclerides in less than 10 numbers were observed in *C. citriodorum*, *C. dubium*, *C. verum*, *C. capparucoronae* and *C. ovalifolium* whereas more than 20 sclerides of oval or round shape were observed in the pith in *C. litsiaefolium* and *C. sinharajensis*. Mucilage cells were observed both in the pith and cortex of *C. citriodorum*, *C. litsiaefolium* and *C. rivulorum*. In *C. capparucoronae*, *C. litsiaefolium* and *C. verum* tannin cells were present in both vascular region and the cortex. However, in *C. citriodorum*, *C. sinharajensis* and *C. ovalifolium* tannin cells were observed only in the cortex and in rest of the species they were observed in the vascular region. Therefore, some anatomical characters of the stem of *Cinnamomum* could be considered as diagnostic characters for the taxonomic identification and separation of *Cinnamomum* species in Sri Lanka. However, these preliminary data must be confirmed with further studies based on more samples covering the whole country.

Keywords: *Cinnamomum*, stem anatomy, shape, diagnostic characters, identification

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Screening of antibacterial effect of selected plant leaf extracts

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Sri Lankans have been using plant extracts to treat various diseases and wounds for years. Those plants contain various chemical compounds that have wound healing properties. The wound healing mechanisms may differ with the compound. One of the prevalent mechanisms of wound healing by plant extract has been identified is the prevention of microbial infections. Our objective of this study was to evaluate & compare the antibacterial potential of plant extracts, which are commonly used in Sri Lanka for wound healing. In this study, water extracts of tender and mature leaves of *Piper betel*, *Clidemia hirta*, *Mikania micrantha*, *Coffea arabica*, *Albizia odoratissima* and *Lantana camara* were evaluated for their antibacterial effect using Soxhlet extraction method. Those plant extracts were tested against pathogenic bacteria namely *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* by agar well diffusion method. The results revealed that all investigated water extracts exhibited antibacterial activity against at least one of the test organisms except *C. arabica* and *A. odoratissima*. However, *S. aureus* was more vulnerable than *E. coli* and *P. aeruginosa*. Those plant extracts showed significant ($p < 0.05$) antibacterial activity against all bacterial strains tested. Effects of the extracts were proportional to the concentration of the extracts tested. The results also indicated that mature leaves of *C. hirta* extract showed the highest inhibition against *S. aureus* at the lowest concentration. Comparatively, mature leaves showed the best antibacterial activity than the tender leaves. Study shows that strong antibacterial activity is shown by aqueous extracts of almost all the investigated plants except *C. arabica* and *A. odoratissima*.

Keywords: Antibacterial activity, Inhibition, Plant extracts, Wound healing

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Evaluation of the antioxidant potential of fruit wine prepared from conkerberry, *Carissa spinarum* L. (Apocynaceae)

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The availability of abundant unutilized fruit species could be commercially exploited by developing value-added products out of them. Alcoholic fermentation/winemaking is one such economic approach that could be used to address this issue. However, value addition to underutilized fruits faces several challenges such as short shelf-life, non-availability of proper handling techniques and inadequate knowledge on nutritional aspects. As a result, these fruit species are wasted especially during the fruiting season. Therefore, the objective of the present study was to assess the antioxidant potential of the fruit wine prepared from *Carissa spinarum* L. Four *in-vitro* spectrophotometric dependent assays were employed such as total antioxidant activity (TAC), reducing power assay (RPA), 1,1-diphenyl-2-picrylhydrazyl (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid (ABTS). Results revealed that the developed wine was able to scavenge the free radicals in a dose-dependent manner with increasing concentration. However, *C. spinarum* juice exhibited higher antioxidant potential than that of wine with respect to TAC and DPPH assays. Further, statistical analysis, viz. two-way ANOVA revealed that all the results were statistically significant with $p < 0.0001$. With these results, it can be concluded that the wine produced with *C. spinarum* fruits has additional benefits of profound antioxidant property.

Keywords: *Carissa spinarum* L., Conkerberry, Minor fruit, Antioxidant potential, Fruit wine

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Identification of superior Nili Ravi buffalo bulls (*Bubalus bubalis*) for increasing milk production through selection by estimation of breeding values and genome analyses

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Buffalo is considered as the best dairy animal in livestock as it contributes about 61% to the total milk production in Pakistan. Novel genetic tools are being developed to discover variants with better milk quality and yield, and uncovering of inherited markers is vital to map and characterize quantitative traits for superior bull selection. Genotyping by sequencing (GBS) is flexible and novel approach to provide standard markers for genome analyses. This study aimed to find the mutual effect of milk production associated genes on its yield and quality by GBS analysis in order to identify superior buffalo bulls that ultimately enhanced the milk production. DNA was extracted from 150 blood samples of healthy bulls with respect to their physical and reproductive parameters, and restriction digestion of the whole genome was done. Furthermore, overhangs of restricted fragments were ligated with adapters. Then all samples were pooled and amplified with primers complementary to adapter sequences. These amplified products were further purified and quantified for sequencing by adding 3'-sequences compatible to flow-cell oligonucleotides. Then single nucleotide polymorphism (SNP) genotype profile was created to process GBS raw profiles to make it as data. The results of the GBS analyses provided evidence for the mutual effect of milk production associated genes on its yield and quality. Selection of bulls by this approach helped to identify real superior breed in terms of high milk production rate so that they could be used in Artificial Insemination (AI) programs to improve the genetic value of buffaloes in the country.

Keywords: Buffalo milk, genotyping by sequencing, milk production associated genes, single nucleotide polymorphism

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Study of the damage of two-spotted mite *Oligonychus* spp. on *Gliricidia*, and characterization of a fungus *Rhizopus* spp. infecting the mite

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Mites are severe pests of crops and are difficult to manage when their population is very high supported by the changing environmental conditions. Rising of temperature in the atmosphere may help to increase the population of mites, and therefore, natural mechanisms are needed to be identified to manage such pests and to establish sustainable management tactics. This may minimize unnecessary use of pesticides in the ecosystem. The present qualitative study is carried out to describe the damage of the two spotted mite, *Oligonychus* sp on the fodder crop, *Gliricidia* sp. and to characterize the subsequent natural infection of a fungus on this mite. *Oligonychus* spp with the characteristic two spots on its idiosoma was found damaging on leaves of *Gliricidia* sp. The chlorophyll in all the leaves of *Gliricidia* was scrapped out and the leaves looked white/bleached due to severe feeding. The removed exoskeleton of the mite was also found adaxial surface of the leaf. Careful examination of the cadavers of mite at the laboratory revealed an infection of a fungus on *Oligonychus* sp. fed on *Gliricidia* leaves. The fungus profusely produced whitish mycelium in PDA. The hyaline, aseptate cottony mycelia produced unique dark sporangiophores and sporangia. Mycosis development was prudent on all stages of the mites and proliferation of mycelium was found on the body of the mites. Subsequent examination in the laboratory confirmed the infectivity of the fungus on the mites. Microscopic examination of aerial growth revealed numerous sporangia-bearing sporangiophores arising directly opposite to the rhizoids. The morphological characteristics of the isolated fungus from the diseased cadavers of *Oligonychus* sp. mites were used and diagnosed the fungus as *Rhizopus* sp. This fungal infection on the mite reveals the existence of natural mechanism of control of pests if the ecosystem is undisturbed and suitable environment prevails.

Keywords: Acaropathogenic fungus, *Gliricidia* leaf damage, *Oligonychus*, two-spotted mite.

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Comparative assessment of the treatment performance and water quality in Kahawatta and Godakawela drinking water processing plants

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Water treatment produces water that is fit for domestic use reliably and consistently from a raw water source, at a cost that is reasonable to the consumers. The main objective of this study was to compare the treatment efficiencies and water quality of Kahawatta and Godakawela drinking water treatment plants (WTP). These two plants were specifically selected due to the request from National water supply and drainage board as they had received complaints from consumers. Water samples were collected twice a month for a period of four months, at four different treatment stages (at raw water, after sedimentation, after filtration and at storage) in the two treatment plants. Three replicates of each sample were tested for pH, EC, temperature, color, turbidity, dissolved oxygen (DO), total iron, sulphate, residual chlorine, chloride, total alkalinity, total hardness, magnesium, calcium, total dissolved solids (TDS), biological oxygen demand (BOD), total coliform, and *Escherichia coli*. The cost for chemicals was also determined. Results of all parameters except pH demonstrated that raw water used by Kahawatta plant was more polluted than that of Godakawela ($p < 0.05$). Overall removal efficiencies of turbidity, total hardness and total iron of Kahawatta plant was 94.41% ,16.47%, 63.67% and that of Godakawela plant was 89.38% , 21.63% and 72.86%, respectively. The microbial removal efficiency of both plants was 100% at the end of the purification. The chemical costs per production of 1 m³ of water were almost similar in both plants (Rs 0.9 per m³). All water quality parameters of final treated water in Kahawatta and Godakawela WTPs were within the permissible limit except residual chlorine which was slightly higher than the permissible limit of SLS.

Keywords: Treatment efficiency, water treatment plant, water quality

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Evaluation of *in vitro* antioxidant and sunscreens activities of different solvent extracts obtained from *Drypetes sepiaria* (Weera) leaves

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In this study *in vitro* antioxidant and sunscreens activities of extracts obtained from *Drypetes sepiaria* (Weera) leaves grown in Sri Lanka were evaluated. The two different solvent systems, 70% aqueous acetone and 80% aqueous ethanol were used to prepare crude extracts from oven dried leaves of the plant. The defatted crude extracts prepared were subjected to preliminary phytochemical screening. The total phenolic and flavonoid contents were evaluated by using Folin-Ciocalteu assay and aluminiumchloride colorimetric methods. The *in vitro* antioxidant and *in vitro* sunscreens activities were evaluated by using 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and UV-vis spectroscopic measurements followed by Mansur equation for the calculations of SPF values respectively. The results of phytochemical screening tests indicated the presence of phenolic compounds, flavonoids, saponins, carbohydrates and absence of alkaloids in both leaf extracts. The total phenolic content determined for the two extracts were 2.539±0.215 (70% acetone extract) and 3.478±0.299 (80% methanol extract) g Gallic acid equivalents (GAE)/100 g dry weight (DW) of the leaves. Total flavonoid content for the two extracts were 1.454±0.109 (70% acetone extract) and 2.285±0.243 (80% methanol extract) g Catechin equivalents (CAE)/100 g DW of the leaves. Antioxidant capacity for the two extracts were 1.932±0.142 (70% acetone extract) and 2.468±0.204 (80% methanol extract) mmol Trolox equivalents/100 g DW of the leaves. The 80% methanol leaf extract of *Drypetes sepiaria* showed significant sun protective factor of (SPF) 31 at the concentration of 1 mg/mL. The results indicated that *Drypetes sepiaria* leaves which contain high total phenolic, flavonoid contents, have promising antioxidant and sunscreens activities.

Keywords: Sunscreens activity, antioxidant activity, total phenolic content, total flavonoid content

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Monsoon effect on the variation of groundwater quality in Vavuniya City area, Sri Lanka

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Groundwater is one of most precious natural resources and the assessment of groundwater quality is the key towards protecting and conserving the quality of groundwater. The objective of this study is to assess the groundwater quality of Vavuniya city during pre and post- monsoon phases and identify the monsoon effect on groundwater quality variation. Samples were collected from Nine (09) common drinking water wells within the radius of 5 km from the centre of the Vavuniya town during the year 2016 (Pre-monsoon: July, August and September) and 2017 (post-monsoon: January, February and March). Electrical conductivity (EC), Turbidity, total dissolved solids (TDS) and pH were tested at the site using portable HACH branded instruments. Total hardness (TH), Calcium and chloride ions were measured by titrimetric method and nitrate, phosphate, fluoride and sulphate ions were measured by reference method of HACH DR5000 at regional laboratory Vavuniya. All the testing procedures were based on APHA (2005) and SLS 614:2013. Turbidity, EC, TDS, TH, and Calcium, nitrate, phosphate and chloride ions were high in post-monsoon period than pre monsoon period. pH and Alkalinity were almost the same in both periods and fluoride was high in pre-monsoon than post monsoon. High turbidity, high concentration of ions and high hardness in post-monsoon period may be due to dissociation and leachate of geochemical compounds into groundwater with rain, and contamination of well-water by runoff and seepage. High concentration of fluoride in groundwater may be due to high evaporation rate in pre-monsoon period. Mostly EC, TDS, TH, alkalinity and fluoride ion concentration were above the SLS 614:2013 level while turbidity, Calcium ions, nitrate and phosphate ions, and pH were within the SLS 614:2013 level in both periods.

Keywords: Groundwater, pre-monsoon, post-monsoon

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TLC Fingerprint profile analysis of leaf extracts of six antidiabetic medicinal plants widely used in Sri Lanka.

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At present quality assurance of herbal products is highly important along with the scientific validation. Chromatographic fingerprinting is one of the widely used approaches in quality control of herbal medicine. This study was aimed at the development of TLC fingerprint profiles of aqueous and alcoholic extracts of the leaves of six widely used antidiabetic herbal plants in Sri Lanka; *Costus speciosus* (Thebu), *Scoparia dulcis* (Walkoththamalli), *Cassia auriculata* (Ranawara), *Gymnema sylvestre* (Masbadda), *Coccinia grandis* (Kowakka) and *Averrhoa carambola* (Kamaranga). The phytochemical screening was carried out for the alcoholic extract of each leaf. The best solvent system, which gave both the maximum number and the highest separation of compounds, was identified for each extract. According to the results of phytochemical screening, secondary metabolites like alkaloids, flavonoids, terpenoids and saponins were identified and labeled them with corresponding R_f values for different leaf extracts. The comparative TLC analysis of the extracts were also carried out to identify compounds those have the same R_f values in different leaf extracts.

Keywords: TLC fingerprint, medicinal plants, antidiabetic, secondary metabolites.

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Isolation and characterization of mangrove endophytic fungi

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Endophytes are ubiquitous in most plants and they are by definition, the microorganisms that reside in the plant tissues, colonizing locally as well as systemically without causing harm to the particular plant. As different plant parts represent different cytological environments, it is believed that diverse microbial flora might reside in these plant tissues. Considering the scarcity of records regarding mangrove endophytic fungi in Sri Lanka, a preliminary study for leaf endophytic fungi was carried out. Present study was conducted to isolate fungal leaf endophytes from mangrove leaves and to determine their beneficial characteristics. Endophytic fungi were isolated from the inner tissues of leaves of four true mangrove species namely *Avicennia marina*, *Bruguiera gymnorhiza*, *Lumnitzera racemosa* and *Rhizophora mucronata*. Twelve different fungal isolates were obtained according to the morphological differences visible through plate culture and slide culture technique. Each isolate was separately tested for extracellular enzyme production (amylase, pectinase, cellulase, chitosanase, laccase), antimicrobial compound production (Test organisms – *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Candida albicans*) and phosphate solubilization. From the total of 12 isolates, AMF1, AMF2 were able to produce laccase. All the isolates except for LRF1 were able to produce chitosanase. For amylase, pectinase and cellulase production, Enzyme Index (EI) was determined and isolates LRF3, BGF2 and AMF2 showed highest EI for amylase, pectinase and cellulase enzymes accordingly. For bioactive compound production, isolated endophytic fungi had the ability to produce antibiotics and antifungals. Nine isolates were able to demonstrate moderate or higher inhibition against at least one test organism. AMF2, BGF1 were able to demonstrate phosphate solubilization. In overall, each fungal isolate was able to demonstrate its ability for at least one character they were experimented for. With the results of the study, it was clear that the isolated fungi had many beneficial abilities and that they should be further experimented to be used in the industrial processes.

Keywords – leaf endophytes, mangrove, fungi, enzymes, antimicrobials

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***Terminalia arjuna* attenuates glycation and glycation induced cross-linking; An *in vitro* study**

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Non-enzymatic glycation leads to the formation of advanced glycation end-products (AGEs) which are key mediators of the pathogenesis of chronic diabetic complications and of accelerated skin ageing. Intermolecular cross-linking is caused by some AGEs, affecting the function of the target molecule. Collagen is a primary target of such AGE mediated changes. The objective of this study was to investigate the inhibitory effects of *Terminalia arjuna* (family *Combretaceae*) bark methanol extract on glycation and glycation induced cross-linking using polyacrylamide gel electrophoresis under native and denaturing conditions. Bovine serum albumin (BSA) and lysozyme were incubated with 0.5 M fructose for 21 days at 37°C and pH 7.4, in the presence or absence of different concentrations (0.01 - 1 mg/mL) of the bark methanol extract. Appropriate controls and the standard glycation inhibitor aminoguanidine (1 mg/mL) were used. Aliquots from BSA and lysozyme were analyzed using native polyacrylamide gel electrophoresis (PAGE) and sodium dodecyl polyacrylamide gel electrophoresis (SDS-PAGE) respectively. Glycated BSA showed an increase in the migration towards the anode with PAGE, when compared with that of non-glycated BSA. High molecular bands were visible with SDS-PAGE, depending on the extent of lysozyme cross-linking. *T. arjuna* showed inhibitory effects on glycation and glycation induced protein cross-linking at all the concentrations used from 0.01 to 1 mg/mL. In conclusion, methanol extract of *T. arjuna* bark showed strong *in vitro* inhibitory effects on glycation and glycation induced protein cross-linking, indicating the value of further studies.

Keywords: *Terminalia arjuna*, glycation, cross-linking

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Land-use/cover changes in the city of Hambantota, Sri Lanka, over the past two decades – a field validated GIS study

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The city of Hambantota has been gaining attention with establishment of a new airport nearby and a sea port as well as many other accelerated and rapid development projects after the devastation of the city by Tsunami in 2004. As such development activities could disturb equilibrium among socio-economic status, ecosystem functioning and services of an area, it is worth to study such impacts and the quantification of land cover/use changes in the area is a pre-requisite for such studies. Hence, the land-use/cover changes of the Hambantota city area were studied using remotely sensed maps of 1996 and 2016. Hambantota city was defined in the 2013 city map of Sri Lanka published by the Survey Department and all adjacent Grama Niladhari divisions were also taken as the study area. Google earth 2016 images were transferred and geo-referenced in ArcGis 10.1 interface. Different land-uses were mapped, and a proper field validation was done including a questionnaire survey. The 2016 map was overlaid with 1996 land-use map of the area obtained from the Survey Department. Area estimations were done for each land-use class in both maps followed by an area loss/gain analysis. Results show that structural complexity and patch density (PD) of urban land-use have been significantly increased. For example, PD in 2016 is three times larger compared to 1996 and settlements have increased by ~15% (579.2 ha) replacing scrublands, chena and dry forests [reduction by ~21% (834.8 ha)] in Hambantota city area. This indicates rapid physical development, but a loss in the green cover has also taken place simultaneously. Moreover, cultivations have also increased by 8.2% (318.4 ha) replacing scrublands. A considerable area of saltpan (201.6 ha) has been lost due to construction of Hambantota port and the remaining area has now become non-functional. Therefore, the trajectory of spatio-temporal changes may indicate that Hambantota is moving away from 'green city' status. Hence, immediate reforestation and environment protection policy enforcement are utmost important.

Keywords: *Urbanization, land-use/cover, spatio-temporal changes, sustainability, settlements*

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Assessment of water quality surveillance activities in a MOH area: A case study from Bope-Poddala, Galle

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Water quality surveillance is a main strategy to ensure provision of safe water for public. Assessment of current water quality monitoring practices employed in MOH areas is particularly important to identify the gaps and to take mitigation measures further. This case study was performed to assess water quality surveillance activities in MOH area, Bope-Poddala in Galle district involving all range Public Health Inspectors (PHI's) in the MOH area. Government circulars and regulations were reviewed, and a data sheet was developed to assess logistical availability, process of sending samples and receiving reports and actions taken. There were four range PHIs within the MOH area, and registry of public water sources and maps were not available even with a single PHI. Altogether 47 water samples were collected throughout the year (11.7 per PHI) following routine random selection process. Except one sample, all others were collected from private water sources. Out of the 47, PHI's had sent all of those for bacteriological testing to the National Institute of Health Sciences but only three samples were subjected for chemical testing for selected ions. Reports had been received for all requested bacteriological tests. But none of the chemical test reports were received. Out of 47 samples, only 17 samples were positive for microbial tests, and in 15 instances, actions were taken against by the authorities. The PHI's were less equipped with necessary test kits whereas no one had chlorine checking kits. Practice of maintaining necessary records by them was not adequate. It was perceived that albeit poor facilities, PHI's were doing water sampling, testing and taking corrective measures to a certain extent, but not reaching the satisfactory level required for proper surveillance. It is recommended that PHI's should be motivated to practice proper surveillance through maintaining necessary documents.

Keywords: Public Health Inspectors; water quality surveillance

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Surface water quality of Bisodola water source in Ratnapura, Sri Lanka

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This study was conducted to explore the surface water quality and water pollution status in ‘Bisodola’ water source. Water quality analysis in five sampling locations (L₁, L₂, L₃, L₄ and L₅) was done biweekly from August to November 2016, in order to identify the water contamination sources in the catchment. Water quality parameters monitored in this study were pH, electrical conductivity (EC), total alkalinity, total dissolved solids (TDS), turbidity, color, total hardness, chloride, sulphate, phosphate, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total coliform and *Escherichia coli*. In addition, a questionnaire survey was also conducted to evaluate anthropogenic activities on the Bisodola catchment. Most of the parameters such as color, pH, EC, TDS, turbidity, chloride, alkalinity and total hardness were within the permissible limits, when compared to SLS standard levels. But, BOD, COD, nitrate, nitrite and phosphate levels were exceeded standard permissive levels. High levels of coliform and *E. coli* were observed in every location sampled in the study. Improper constructions of pit latrines by villagers may cause for excessive runoff in rainy seasons and it may be the reason for high *E.coli* and coliform content in the Bisodola stream. Total hardness, EC, TDS, color, BOD and COD of water were significantly differed in the location five (L₅) compared to other locations (L₁, L₂, L₃ and L₄). The questionnaire survey revealed that, anthropogenic activities such as agricultural practices, wastewater discharges, and poor sanitary facilities were the reasons for the surface water quality variations in the catchment. Improper fertilizer application for plantations in the catchment appeared to be a reason for elevated levels of nitrate, nitrite, and phosphate in the surface water in the Bisodola catchment. The water quality index for the Bisodola stream was 79 according to Canadian Council Ministry of Environment (CCME) and it has been ranked as a fair water quality. However, the water quality of Bisodola stream is not consistent and fluctuate time to time posing a threat on the health of consumers.

Keywords: Anthropogenic activities, Bisodola catchment, CCME water quality index, water quality

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A case study on developing an industrial symbiosis using a multi-industrial approach

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Industries in Sri Lanka generate a large amount of wastes which are either dumped or disposed without consideration of the environment. The haphazard disposal of the untreated waste is growing in to a major problem in the country due to the high cost of treatment, lack of infrastructure, ineffective enforcement of environmental regulations and insufficient capacity for waste management of local authorities. This abstract presents a case study conducted to evaluate the potential of applying an Industrial Symbiosis for the Sri Lankan industrial sector to identify the secondary usage of waste, avoiding direct discharge in to the environment. Data were collected using a questionnaire and secondary data bases. The results showed that the textile and apparel, food, ceramic and rubber industries are the major effluent treatment-sludge-producers, totaling 40,900 MT (Metric Tons) per annum amounting to 80% of the ETP-sludge (Effluent Treatment Process) generated. The textile sector generates around 35000 MT of fabric off-cuts including cotton, polyester, Nylon, and mixed materials. In addition, the rubber sector disposes around 37000 MT of annual waste during different manufacturing stages. This kind of concept is applied in between waste generators and waste users considering feasibility to establish under appropriate geographical conditions as well as financial facilities. Resource scarcity, inefficient environmental protocols, time frames and the risks involved in adopting new technologies have been identified as barriers. According to the economic and environmental point of view, the results gained by applying the theories of industrial symbiosis give more benefits. The overall conclusions are that the most of the industries in the country generate wastes which can be used as alternatives and if the government policy supports this effort, private sector could contribute more in increasing the use of process and packing wastes.

Keywords: Alternative raw material, ETP sludge, industrial symbiosis, Sri Lankan manufacturing sector

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Quartz impregnated nitrile butadiene rubber (NBR) for high ware resistant applications; preliminary study

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Mineral powders are used as fillers in the preparation of polymer composites. In this study, quartz powder was added to nitrile butadiene rubber (NBR) and ware resistance of the resulting composite was measured by changing the amount of quartz powder. NBR was used as the matrix and quartz powder was added as the filler with variation of filler content viz. 5, 10, 15, and 20 (%wt.). To maintain the strength of the polymer composite, quartz powder with < 63 μ m (63 mesh sizes) was selected. The composite was prepared using film preparation method. EN 388 abrasion test method was used to measure the ware resistance of the composite. The result showed that the optimum ware resistant is achieved with 5 (%wt.) filler content. Therefore, quartz impregnated NBR could be introduced to polymer industry as a cost effective, high abrasion resistance and eco-friendly composite.

Keywords: Composite, Mineral, abrasion, filler.

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Right to clean and healthy environment and E-waste in Sri Lanka: A way forward

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Electronic waste or E-waste is one of the serious problems which creates many health and environmental problems in Sri Lanka, as they may contain a lot of hazardous constituents. In the era of human right-based approaches, global and regional human rights bodies have considered the link between the environmental degradation and human rights, including the right to clean and healthy environment. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989) and The Rotterdam Convention (2004) are dealing with some issues regarding E-waste and chemicals. In the domestic scenario, National Environmental Act, No 47 of 1980, being the principal piece of legislation for the protection of environment, as amended by Act No 56 of 1998 states that no person shall discharge, deposit, or emit waste into the environment without a license. National Environmental (Protection and Quality) Regulations, No 1 of 2008 was also aimed to prevent and minimize the negative impacts to the environment and health due to the disposal of waste. Despite this, there is no specific law dealing with E-waste in Sri Lanka. This research mainly follows a qualitative research method based on a literature review and carried out by the reference of primary and secondary sources of law. The aim was to investigate whether there is an inadequacy of the current legal framework in Sri Lanka to protect the right to clean and healthy environment. The results led to the conclusion that the legal framework in Sri Lanka regarding the proper disposal of E-Waste is not adequate, and need of a reform is an emerged issue. Introducing new legislation, which include the responsibilities of stakeholders and extended producer liability on E-waste and covers matters such as, generation, transportation, treatment, storage, and disposal within all stakeholders regarding the E-products is necessary. Furthermore, promoting research and development activities on products free of hazardous materials, and on safe E-waste recycling technology is needed while enhancing public awareness on E-waste management is among recommendations. A comparative analysis of successful examples from India has been carried out in order to assure these recommendations.

Key words: E-waste, right to clean and healthy environment

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Impact of agrochemical usage of paddy cultivation at Welipothewelayaya, Thissamaharama in Sri Lanka.

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The impact of the use of agrochemicals on paddy cultivation at Welipothewelayaya in Hambantota district was investigated. Two sites selected for this study were named as organic farming site (OFS) and conventional farming site (CFS). Only organic fertilizers and not any chemical fertilizers and pesticides have been used at OFS during the last six-years whereas chemical fertilizers and pesticides have extensively been used at CFS. Soil and water quality parameters; pH, conductivity, DO, COD, Hardness, P-content, Pb-content, and NO_3^- -N content of these two sites were analyzed using chemical, UV-vis and AAS spectroscopic methods. In addition, 10 rice samples from both sites were analyzed for Cd content using ICP-MS. The COD and total hardness of water found to be 41.6% and 18.5% respectively which are higher in CFS than OFS. The determined P-content, Pb-content and NO_3^- -N content of soil are also 24.0%, 43.2%, and 36.8% respectively again higher in CFS than OFS. The pH of both sites found to be slightly alkaline and comparable. In addition, the analysis of Cd-content of rice samples from OFS gave 6-8 ng/g whereas that of from CFS showed 30-60 ng/g, indicating that Cd-content of the rice samples obtained from CFS is considerably high. These results revealed that most of the soil and water quality parameters, as well as Cd-content of rice at CFS, are considerably high compared to OFS due to extensive usage of agrochemicals. Therefore, it is clearly evident from this studies that there can be a future health risk to human due to conventional farming methods.

Keywords: paddy cultivation, conventional & organic farming, agrochemical usage, heavy metals

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Isolation and characterization of Pomelo pectin and preparation of pectin derived Ag nanoparticles

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In this work pectin was isolated from pomelo (*Citrus maxima* sp.) peels and Ag nanoparticles were prepared in aqueous medium using isolated pectin with AgNO₃ which is the silver precursor. Chemical confirmatory tests were carried out to identify the characteristics of the isolated pectin. It was found that the isolated pectin which is free from starch, is a non-reducing sugar and mainly consist of glycosides having jelly properties. Qualitative tests were carried out to study the solubility of pectin in hot/cold water and hot/cold alkali. Equivalent weight, methoxyl content, anhydrouronic acid content and degree of esterification were determined by titrimetric methods. Low esterification degree (<36.8%) indicates that isolated pomelo pectin is a low methoxyl pectin. According PXRD analysis, pomelo pectin was found to be amorphous in nature. FTIR spectra of isolated pectin revealed the existence of functional groups such as alcohol, carbohydrate ring, unsaturated ester, carboxylic acid, aliphatic amine and alkyl halide. Color change to yellow was used as an indicator to the formation of silver nanoparticles. Pomelo pectin derived silver nanoparticles were confirmed by UV-vis spectroscopy and their morphologies were examined through TEM. Spherical like structures with dark cores were observed for the nanoparticles and the dark core corresponds to nanosilver. They exhibited mean diameters ranging from 2-4 nm.

Keywords: silver nanoparticles, pectin, degree of esterification, anhydrouronic acid content

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Green approach for conversion of industrial wastes to biofuel over egg-shell CaO catalyst

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In this work biofuel was produced by esterification of coconut oil extracted from the waste scraped coconut using two methods *viz* non-microwave and microwave methods. CaO catalyst was prepared by treating waste chicken egg shells and the catalyst support which is H₃PO₄ acid activated carbon (AC) was prepared by using sugarcane bagasse. CaO content of the egg shells derived CaO was determined by EDTA titration and compared with that of commercial CaO. According to the results obtained, the best catalytic activity was found under the condition of, CaO: AC (w/w) 1:1, oil:methanol (mol/mol) 1:12 and 2% CaO (w%) catalyst. In the microwave method biofuel was formed in 97% yield upon exposure to microwave radiation for just 5 min. The biofuel produced from coconut waste was characterized by determining the pH, density, total acid content, iodine value and ash content and the values were well agreed with the standard ASTM parameters. In conclusion it is clear that a few readily available industrial wastes can be efficiently used to produce biofuel economically under environment friendly conditions.

Keywords: Biofuel, CaO catalyst, Activated carbon, sugarcane bagasse

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Mid Upper Arm Circumference-for-age: an alternative method of assessing acute under-nutrition among preschool children

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In anthropometry, single measurement would be more convenient than taking two measurements to assess the malnutrition. Mid Upper Arm Circumference (MUAC)-for-age is preferable, especially in larger populations, as it is less time consuming. This study compared MUAC-for-age Z-scores (MUACZ) and weight-for-height Z-scores (WHZ) for the assessment of acute undernutrition among preschool children through a descriptive cross sectional study among 1400 children aged 6-36 months in Batticaloa and Kalmunai (Eastern Province, Sri Lanka) health districts. All measurements were taken by trained persons according to the standard protocols using calibrated equipment, after obtaining the informed written consent. Ethical clearance was obtained by a local ethical review committee. Descriptive statistics and logistic regression were performed using SPSS and WHO-anthro. The prevalence of MUACZ < -2 was 16.8% [95% confidence interval (CI); 14.1, 18.9] with the mean of -1.35 ± 0.65 (mean \pm SD). The prevalence of WHZ < -2 was 21.5% (95% CI; 18.8, 24.4) with the mean of -0.74 ± 1.12 . There was a considerable difference between the actual percentages of these two nutritional indicators. But the predictor like poor education, young mother, lower income and delayed commencement of complementary feeding were significantly ($p < 0.05$) associated with both nutritional indicators having higher odds ratios. However, assessing MUACZ is easier in comparison with WHZ where the latter requires two measurements to calculate. Therefore, MUACZ can be used to assess acute under-nutrition especially in field surveys and in situations where support personnel and materials are inadequate, and when screening large populations.

Keywords: low MUACZ, under-nutrition, wasting

Acknowledgements Financial assistance given by Higher Education for the Twenty first Century (HETC Grant No: HETC/CMB/QIGW3/MED/TOR-04) of Sri Lanka is acknowledged.

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Maternal urinary iodine status and its relationship to newborn's thyroid status in selected MOH divisions of Jaffna district

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Iodine is an essential element in thyroid hormone synthesis, normal growth and development of the brain. The objective of this study was to investigate the maternal iodine status and its relationship to newborn's thyroid status in selected MOH divisions of Jaffna district. A total of 477 mothers and their 477 newborns in Jaffna District were included in the study program during July 2012 to December 2013. Urinary iodide concentration (UIC) was measured in pregnant mothers by Sandell–Kolthoff reaction, and blood spot TSH levels of their newborns were measured by Enzyme-Linked Immunosorbent Assay (ELISA) method within one week of delivery. Descriptive statistical analyses were done with SPSS version 16. Mean weight and height of mothers were 63 ± 11 kg and 154 ± 6 cm respectively. Among the 477 mothers, median UIC was $140.0 \mu\text{g/L}$. Also 65.1% ($n=311$), 22.7% and 11.7% ($n=57$) ($n=109$) of mothers had UIC less than adequate ($<150.0 \mu\text{g/L}$), adequate ($150 - 250 \mu\text{g/L}$) and excess (greater than $250.0 \mu\text{g/L}$) level of iodine excretion in their urine respectively. Among the 477 newborns, 18% ($n=86$) of them had blood spot TSH level greater than 20.0 mIU/L . Neonatal TSH levels ranged $1.50-53.46$, $1.00 - 42.50$ and $2.00 - 45.50 \text{ mIU/L}$ were obtained in corresponding to the maternal UIC levels less than adequate, adequate and excess respectively. Maternal UIC was not significantly correlated with neonatal TSH level ($r = 0.06$, $P = 0.13$). Based on this study, maternal iodine deficiency and excess were observed in mothers at third trimester of gestation. High and low values of neonatal TSH levels were observed among newborns delivered by iodine deficient and excess mothers in Jaffna district, yet maternal UIC was not significantly correlated with neonatal TSH.

Keywords: Jaffna, maternal urinary iodide, neonatal TSH, thyroid-stimulating hormone

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Qualitative study on Experiences and challenges perceived by informal caregivers of Elders in Batticaloa District

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The global and national ageing population has led to much health, social and economic concerns. Increased prevalence of long-term disability in the elderly population requires formal or informal care giving by the care givers. The study is aimed at exploring the experiences and challenges perceived by care givers of elders in Batticaloa district, Sri Lanka. This study used qualitative approach. In-depth interviews were conducted using semi structured interview guide in a sample of 20 purposely selected caregivers of elders, attending in selected primary care centers in the district. Data were transcribed and analysed using content analysis method. In this study, majority of care givers (19/20) were females. Among them fourteen were daughters and five were spouses of the elders. Three major themes were emerged from the qualitative data. Care givers perceived that care giving as an activity of 'happy and blessing' while they experienced 'high prioritization for activities of daily living and low for entertainment and recreational activities'. In addition, 'financial crisis and unemployability were the challenges during their process of care giving. Encouragement for informal care giving is essential with provision of adequate recreational opportunities along with financial upliftment for care givers. Informal care giving needs to be professional with appropriate training in order to overcome the challenges.

Keywords: Batticaloa, challenges, elderly care, informal care givers

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Knowledge and practices regarding sugar and salt consumption among government servants in a selected Divisional Secretary office

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Unhealthy diet is one of the major risk factors of non-communicable diseases. This study was done to describe knowledge and practices regarding sugar and salt consumption in their diet among government servants in Ambalangoda Divisional Secretary (DS) office (Southern Province, Sri Lanka). Descriptive cross sectional study was done by administering a pre-tested structured self-administered questionnaire, which was prepared after a literature search and obtaining opinion of an expert panel. All the staff in Ambalangoda DS office were invited, and a total of 78 subjects were participated (response rate 84.8%). The majority was males (64.1%) and the mean age was 43.2 ± 7.7 (SD) years. Majority were taking rice on an average day as breakfast (89.7%), followed by bread (7.8%). About half of the subjects reported adding salt when cooking rice in their homes (51.3%) and 10.2% reported consuming more than 6 tea-spoons of sugar per day with tea. About 94.0% reported consuming carbonated drinks once a week and 69.2% reported consuming ice creams at least once a week. Almost all were aware that cakes, carbonated drinks and sweetened milk packets have added sugar. 54.6% didn't know having tea with sugar is a major source of receiving excess sugar in the body. Those who had university degree were more likely than others, not to add salt when cooking rice ($p < 0.01$) and to consume less sugar ($p < 0.01$). Health promotion programs are warranted to correct these unhealthy dietary habits.

Keywords: Dietary habits, non-communicable diseases

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Clinical and histopathological features of patients with cutaneous leishmaniasis in Hambantota, Sri Lanka

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Leishmaniasis is a recently established disease in Sri Lanka, and patients with cutaneous leishmaniasis (CL) have been reported in almost all districts. *Leishmania donovani* has been identified as the causative organism. This research is designed to study the clinical and histopathological features in CL. The study was conducted on CL suspected patients attending the Dermatology clinic in Base Hospital Tangalle from June 2016 to January 2017. After a general clinical examination, characteristic features of the CL lesions were recorded using a structured clinical data sheet. A slit-skin thin smear taken from each patient was stained with Giemsa stain and examined under the light microscope to identify *Leishmania* amastigotes. On the subsequent clinic visit, skin biopsy samples were taken only from the slit-skin smear positive patients. Prepared sections were stained with Haematoxyline/Eosin to observe any histopathological changes. During this study, forty-five (45) skin biopsy samples were collected. Out of four types of lesions, the most common type was nodules. Majority of CL patients had lesions on their upper arms (67.3%). Most of the lesions (57.1%) were wider than 1 mm and lesser than 1 cm in size. Considerable number of lesions was 3 to 6 months old. Dermal changes like mononuclear infiltrate of lymphocytes, macrophages, plasma cells and a few giant cells were seen. In lesions less than 6 months old, large number of L. *Donovani* (LD) bodies could be seen but the LD bodies spread up to deeper layers of the skin when the duration of the lesions increased. The most common epidermal changes of these lesions were hyperkeratosis, parakeratosis and acanthosis. Current findings indicate that the skin biopsy samples can be used for the diagnosis of CL especially the old, ulcerative CL lesions by considering the epidermal and dermal changes in histological sections.

Keywords: Cutaneous leishmaniasis, histopathology, slit-skin smears, skin biopsy

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Impact of three selected companion plants on selection of host plant, *Vigna unguiculata sesquipedalis* by the aphid species, *Aphis craccivora*

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Among emerging alternative pest control strategies, the use of companion plants to protect crops shows promise. In this view, an experimental study was carried out to test the applicability of three plants, namely white chrysanthemum (*Chrysanthemum* spp.), garden mint (*Mentha spicata*) and African marigold (*Tagetes erecta*) as companion plants to control *Aphis craccivora* infesting long bean (*Vigna unguiculata sesquipedalis*). All trials were conducted using a glass test chamber (dia. 12 cm) with a central arena and four compartments, each of which to harbour the plant leaves during separate trials. In each trial, 4th instar larvae (n=10) of the aphid were released to the central arena, and their movement was followed to get the count of aphids in each compartment every 10 minutes up to 40 minutes. The final aphid counts were statistically compared among compartments. In the first trial, when only long bean plant leaves were kept in all compartments, there was no significant difference ($p>0.05$) in aphid number among compartments indicating that the aphid attraction to the host plant was not selective. In the second trial, when four compartments had four different plant leaves (from each candidate companion plant and long bean), marigold and mint leaves had significantly lower aphid numbers ($p<0.05$) compared to long bean leaf, indicating that the former had some repellent action towards aphids. In the third trial, the aphid movement was followed when the long bean leaf was accompanied by a companion plant leaf. When each companion plant leaf was present with the host plant leaf in the same compartment, the attraction of aphids to the host plant leaf was significantly lower ($p<0.05$) than when the host plant leaves were alone (control). The results indicate that all three plants tested can be used as companion plants to reduce aphid infestation in long beans, via their potentially repellent action towards aphids. Among three companion plants, mint shows the best repellent action indicating its potential for controlling aphids of long bean.

Keywords: *Aphis craccivora*, *Chrysanthemum* spp., companion plants, *Mentha spicata*, *Tagetes erecta*

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Effect of sound frequencies of 500 Hz, 20 kHz and 75 kHz on the growth of green gram plants

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Just like people, seeds of plants as well react to the feelings those they are been exposed to. Accordingly, modern technology has tended to apply auditory stress to different seeds of plant towards their enhancement of bioactivities. This project is intended to examine the growth of green gram when unconcealed to three different frequencies. Experiments have been conducted with three different sound frequencies 500 Hz, 20k Hz and 75 kHz covering the entire sound frequency range. Four samples each having four green grams were prepared. One sample was used as a control sample. The other samples were exposed to predetermined sound frequencies 500 Hz, 20k Hz and 75 kHz, separately for 48 hours. Audio Piezo Tweeters were used as a sound wave generator. Accordingly, the dilation of the root, stem and the leaves were recorded. It was detected that sound expose had a positive effect on the green grams germination as compared to the control group and also variant growth of the roots, stems and leaf were observed. The highest length of stem and leaves were measured for green grams sample which was exposed to 20 kHz frequency and the highest root length was recorded when the sample was exposed to 75 kHz frequency. As such, this research further reveals the effect of sound waves on the quickness of germination of green gram seeds and the effect of different frequencies on different parts of the growth plant such as root, stem, and leaf.

Keywords: Audio Piezo Tweeter, Auditory Stress, Bioactivities

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Nickel doped ZnO nanoparticles decreased dissolution and reduced toxicity in Zebrafish (*Danio rerio*) embryos

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Zinc oxide nanoparticle (ZnO NPs) and nickel (Ni) doped ZnO NPs are found to be applied in various kinds dermatological, biomedical and optoelectronic fields. However, available toxicological information is inadequate to assess the potential ecological risk of Ni doped nano-ZnO to aquatic organisms and human. In this study, ZnO NPs and different molar concentrations of Nickel (0–12%) doped ZnO NPs (Ni doped-ZnO NPs) were synthesized and characterized by powder X-ray diffraction, UV–visible diffuse reflectance spectroscopy, field emission scanning electron microscopy (FE-SEM) couple with *energy-dispersive x-ray* (EDX). Moreover, dissolution of Zn^{2+} from ZnO NPs was lowered when increasing the Ni doping. To determine toxicity effect of ZnO NPs and Ni doped-ZnO NPs were investigated using zebrafish embryo and larvae by exposing to different concentrations (1, 5, 10, 15, 20, and 25 mg/L). Furthermore, the toxicity of Ni^{2+} and Zn^{2+} ions, detached from Ni doped-ZnO NPs were investigated to understand the interrelation between ionic Zn^{2+} and Ni^{2+} with the nano-ZnO. The Zn^{2+} content of chorion was measured as 205 ng/embryo and 152 ng/embryo in ZnO NPs (5 $\mu\text{g/mL}$) and 12% Ni doped-ZnO NPs (5 $\mu\text{g/mL}$) respectively. The Zn^{2+} content of chorion interferes in embryo hatching without directly affecting viability. Our results clearly showed the reduced toxic effects of Ni doped nano-ZnO than ZnO NPs in zebrafish embryos and larvae suggesting that Ni doping could be applicable method to reduce the toxicity of ZnO NPs.

Keywords: ZnO NPs; Ni doped-ZnO NPs; Zebrafish; toxicity

Acknowledgement: This work was supported by a National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (2014R1A2A1A11054585).

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Challenges in sustainability practices in Sri Lankan construction industry

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Construction industry plays essential and effective role in the countries' economic sectors. Nowadays most of the countries face the issues such as marked population growth, economic developments and advancements in technology. People build new buildings in natural biodiversity areas, however these types of human activities have created environmental problems. On the other hand, developed countries strictly follow sustainable construction practices. In Sri Lanka, the construction industry plays a major role in the countries' economy. The Government of Sri Lanka focuses on the sustainable practices in construction industry. Moreover, sustainable practices in construction industry faces enforcements of challenges such as unskilled workers' knowledge shortages, complex contracting system, difficulties in implementing new ideas, lack of efforts and involvement from top management, client's expectations, high price and long-time, local authority's commitment and economic competitive. In addition to that, sustainable practices have been considered as the solutions for those challenges such as the awareness programmes about sustainable practices, improve information communication technology, to reduce the effects of cultural barriers introduce time and cost management programmes and top management sustainable efforts.

Keywords: Challenges, sustainability, human behaviours, environmental protection, environmental friendly

Acknowledgements: *I would like to thank to the research questionnaire respondents' construction firms and also thank my major research supervisor Dr S. Renukappa for motivate guidelines.*

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An automated device to release a desired volume of a liquid from a container

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A simple automated device has been designed and constructed in order to release a desired volume of a liquid from a container. A solenoid valve is used to start and stop the release of liquid quickly. The time period of the solenoid valve kept open, which determines the volume of the released liquid, has been programmed electronically for a predetermined rate of flow of the liquid. This preliminary model was tested with water. The device released water at the average rate of $69.114 \pm 0.001 \text{ ml sec}^{-1}$. When the machine was programmed to release 550 ml and tested 50 times, 42%, 18% and 16% of the number of measurements were accurate within ± 0.1 , ± 0.2 and ± 0.3 ml, respectively and the highest deviation was one measurement with 550.6 ml.

By measuring the volume of water released in periods (T) of 1 s to 14 s, each repeating 10 times, and fitting the data, a linear relationship, $V = 68.301T + 8.3795$ with $r^2 = 0.9999$ was obtained for overall calibration to release any desired volume. With this calibration, the device was accurate within 0.5% of the desired volume when the released volume is greater than 300 ml. The error is higher at lower volumes, about 2% for releasing 100 ml.

The machine can be programmed for other liquids, such as kerosene oil and coconut oil so that the users could select the relevant function. There are several advantages of the machine, such as low manufacturing cost (Rs. 15,000.00), easy to manufacture locally, user friendly, less processing time (14 s to release 1000 ml), sufficiently accurate, and easily repairable. Further improvement of the accuracy is in progress including a mechanism to minimize power fluctuations of the motor.

Keywords: Desired liquid volume, Automated device

Acknowledgements: Assistance from the Department of Physics, University of Ruhuna

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A case study on quality control charts in a manufacturing industry

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This research has been done with a one of consumer goods manufacturing company in southern province in Sri Lanka. They mainly focus on manufacturing spices, from that chilli has become the main product. In the chilli production process there is a reasonable wastage according to their past experience. Because of that reasonable number of packets was rejected due to the insufficient weight. Therefore, they mainly concern about the process stability of the packing section. In this study mainly concern about waste minimization of chilli section by controlling the variability of the weight of chilli flakes packets, in a certain chilli packets producing machine using Quality control charts. The factors considered in this study are cups variation, chilli level and weight of chilli flakes packets changed with the time. This study provides empirical evidence on the significant level of weight of a chilli packets, descriptive analysis about weight of a chilli packets, the stability of the process. The relationship between process stability and the chilli level is described in this study and found the optimum chilli level from two considered chilli levels so that least waste occurs.

Keywords: Quality Control Charts, wastage, Quality Control Charts, Process Stability

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Traffic volume pattern and its correlation to traffic noise in Matara city

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Traffic congestion is becoming a serious problem in main cities in Sri Lanka and is rapidly increasing. Hourly traffic volume pattern and noise levels close to Matara Post Office on the Matara – Tangalle road are surveyed and analysed in this study. A video camera (Aisino, 3MP, 170 degree, 1080p, HD) was used to record the traffic movement. Traffic volume was counted from the video clip using Tally sheets. The speeds of vehicles were calculated using the timer in the camera. The noise level was measured using a Bruel & Kjaer hand held analyser Type-2250. Total number of 42401 vehicles passed at the site during the period of study from 6.00 am. to 6.00 pm. The vehicle count is highest, and the speed is lowest during the period of 1.00-2.00 pm. The noise level L_{Aeq} is increased from 72.9 dB at 6.00-7.00 am. to the highest value of 77.5 dB by 2.00 pm. The lower the speeds of vehicles the higher the noise level, because at lower speeds, vehicles run at lower gears. A significant drop in speeds of vehicles and increase of noise after 11.00 am is observed. The number of vehicles on the road is highest (37%) from 10.00 am – 2.00 pm. which may be partially responsible for lower speed and higher noise after 11.00 pm. The measured noise level is much higher than the recommended level of 65 dB reaching the highest level of 77.5 dB at 02.00 pm. The noise level is parameterized using different functional forms of the number of vehicles (N) and speed (v) and the best correlation was observed when the noise is expressed as a power law of the term $\ln(N/v^2)$. It was found that the most important reason for slower traffic is due to the pedestrians crossing the road very frequently at busy hours. Construction of an overpass for pedestrian could solve many problems identified.

Keywords: Traffic volume, Hourly pattern, Vehicle speed, Noise level

Acknowledgement: Authors acknowledge the financial assistance provided by the UGC block grant No: RU/PG-R/16/12.

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Face identification using image processing techniques

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Image processing technique is used to uniquely identify the objects from an image. In that way our research is based upon integrating an efficient image processing technique to uniquely identify face from digital image sources. Cross-correlation, template matching and neural network are integrated to form an efficient technique to identify faces. Firstly, the location of the face will be roughly sketched using cross-correlation from two templates one with brighter background and another one with darker background. Then Searching algorithm in the neural network will recheck and confirm already roughly plotted location. Not only it checks for the peak location, but also it checks all the area around already plotted location. If the output of the network is returned 0.5 for a search location, all the pixel locations will be marked around that pixel to be checked in the next search iteration. The proposed system will be able to identify different types of digital images. This system can be used for some automated statistical analytical purposes. This system will speed up the process of counting than the manual system of counting. The proposed system will be developed using math lab and open CV.

Keywords: Image processing, neural network, cross- correlation, template matching, math lab

Acknowledgements: *I would like to thank my supervisor and all the others who supported to me to conduct this research successfully.*

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Oral vaccination of DNA encapsulated chitosan nanoparticles enhances the transcriptional responses of IFN and IFN-stimulatory genes in zebrafish

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The use of oral vaccination in aquaculture has lagged behind injectable vaccines for a long time in protective immunity. In this study, we constructed the DNA vaccine using plasmid vector (pEGFPN2) and ORF012R gene of rock bream iridovirus (pEGFPN2-ORF012R). Then it was encapsulated to chitosan nanoparticles (CNPs) according to a complex coacervation method and denoted as pEGFPN2-ORF012R-CNPs. The pEGFPN2-ORF012R-CNPs had diameter of 189.5 nm. Encapsulation efficiency and loading capacity were determined as $92.57\% \pm 0.87\%$ and $9.32\% \pm 0.19\%$, respectively. Final encapsulated product (pEGFPN2-ORF012R-CNPs) had +12.11 mV zeta potential. *In vitro* vaccine release assay showed that the plasmid DNA was sustainably released from the pEGFPN2-ORF012R-CNPs, up to $84.26\% \pm 3.16\%$ of the total amount. By *in vitro* cell culture experiment we confirmed that the cloned pEGFPN2-ORF012R-CNP was expressed in HEK-293 cells. Oral vaccination was carried out by feeding of pEGFPN2-ORF012R-CNPs (250 ng/zebrafish/day) for 14 days. Quantitative real time PCR results clearly showed the transcriptional upregulation of IFN and IFN-stimulatory genes (Mx) in kidney and gut of zebrafish upon oral vaccination of pEGFPN2-ORF012R-CNPs compared to control fed diet, suggesting that CNPs is potential DNA vaccine delivery agent.

Keywords: Chitosan nanoparticles; Oral DNA vaccination; Zebra fish

Acknowledgements This work was supported by a National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (2017010990).

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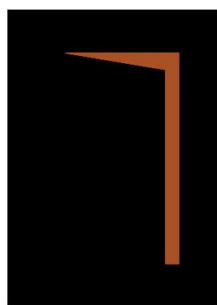
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