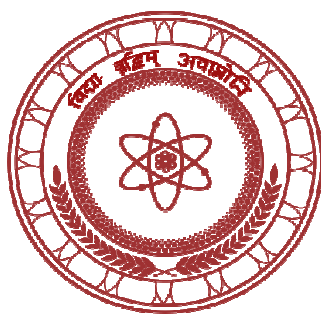


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Part I: Abstracts



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Oral Presentations



Section A

101/A

Protective effects of virgin coconut oil against hepatosteatosis and lipid peroxidation in Wistar rats

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Hepatic steatosis and oxidative stress are main mechanisms involved in the pathogenesis of non alcoholic fatty liver disease (NAFLD). Both quantitative and qualitative aspects of dietary fat influence triglyceride deposition in the liver and the progression to NAFLD. Studies have demonstrated a protective effect of some dietary oils against NAFLD. The aim of the present study was to investigate the effects of virgin coconut oil and white coconut oil on hepatosteatosis and lipid peroxidation in Wistar rats. Five groups of male Wistar rats, with 5 rats per group, were maintained on five test diets. The control group was on the standard rat diet containing soya oil (2%). For test groups 2, 3, 4 and 5 soya oil in the standard recipe was replaced by VCO (2%), WCO (2%), VCO (4%), and WCO (4%) respectively. Rats were maintained on the test diets for 22 weeks and were euthanized and liver tissues were collected. Lipid peroxidation of liver tissues as a marker of hepatic oxidative stress was determined by TBARS assay and expressed as nmolmalonaldehyde (MDA)/ g protein. Histopathology following hematoxylin and eosin staining was done to assess the degree of steatosis. Data were analysed by one way ANOVA using SPSS 23. With the increase of VCO from 2% to 4% in the diet, the hepatic MDA levels significantly decreased (18.7 ± 1.7 vs 14.9 ± 2.7 , $p < 0.05$). In comparison with the 4% VCO diet, the 4% WCO diet resulted in a significantly higher level of lipid peroxidation (14.9 ± 2.7 vs 23.7 ± 6.0 , $p < 0.05$). The increased antioxidant potential of the liver in rats maintained on VCO diets is indicated by the remarkable decline of hepatic lipid peroxidation. The livers of the rats on WCO diets showed significant hepatic steatosis when compared with rats on VCO diets (27.5% vs 3.1%, $p < 0.05$). Although VCO and WCO consist of the same fatty acid profile this difference in hepatic steatosis can also be attributed to their antioxidant properties since hepatic oxidative stress is known to be associated with reduced VLDL secretion leading to the accumulation of triglycerides in the liver. In conclusion, due to its high antioxidant potential dietary VCO exerts a protective effect on the liver by reducing lipid peroxidation and steatosis in Wistar rats.

Key words: Non alcoholic fatty liver disease, lipid peroxidation, hepatosteatosis, oxidative stress, virgin coconut oil.

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102/A

School performance, school attendance and peer pressure contributing to stress among adolescents in Colombo district, Sri Lanka

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Psychosocial adversities at home, at school, and peer pressure are known to contribute to stress amongst adolescents in developed countries. The Adolescent Stress Questionnaire (ASQ) has been used in many populations in the world to assess adolescent stress levels. The objective of the study was to determine factors of school performance, school attendance, and peer pressure that contribute to stress among adolescents in the Colombo district. A descriptive cross-sectional study was conducted among adolescents aged 14 to 16 years ($n=104$; mean age 15.3 years \pm 0.50; 53% female) attending government schools in all four education zones of the Colombo district. Baseline data were obtained and the ASQ was administered after validating into Sinhala Language using the delphi technique. Subjects were divided into stressed ($ASQ \geq 150$) and non-stressed ($ASQ \leq 149$) groups based on ASQ score. Stressed subjects scored worse on 14 of the 17 factors in the ASQ, with the major differences being in relation to subject content difficulty and demands, teacher expectations, and peer pressure. There were no differences in the stress levels between males and females. 37.5 % ($n= 39$) were stressed in relation to stress of school performance, school attendance and peer pressure. The mean ASQ score of the stressed adolescents 178.69 ± 19.55 was significantly higher than the mean ASQ score of the non-stressed adolescents (116.76 ± 19.48 ; $p < 0.001$). The mean score due to school performance was significantly higher in the stressed group (21.0 ± 4.3) than the mean score in the non-stressed group (14.5 ± 3.9 ; $p < 0.0001$). The mean score due to school attendance was significantly higher in the stressed group (6.15 ± 2.6) than the mean score in the non-stressed group (4.88 ± 1.8 ; $p = 0.004$). The mean score due to peer pressure was significantly higher in the stressed group (20.38 ± 3.70) than the mean score in the non-stressed group (13.48 ± 3.86 ; $p < 0.0001$). Factors in school performance school attendance and peer pressure significantly contributed to stress among adolescents. Measures to avoid or minimize stress factors in the school environment need to be adopted for these stressed adolescents to minimize stress and enhance learning.

Key words: Adolescent, school performance, school attendance, peer pressure, stress.

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103/A

**Effects of perceived dental neglect on oral health and oral health related quality of life in
15 to19 year old adolescents attending public schools in Gampaha District**

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Self-care is a necessary human regulatory function which is solely under individual control and it is purposeful and self-initiated. During the transition from the childhood to adolescence, complex and important health care needs will arise, hence it is the critical time period during which the adolescents initiate risk behaviours, if there is no intervention. Dental neglect among adolescents can be explained mainly as failure to fulfil the known knowledge of oral health care for proper maintenance of the oral cavity. Hence it is vital and viable to measure dental neglect among adolescents to assess the effects of dental neglect on oral health. The objective of this study was to assess the effects of perceived dental neglect on oral health and oral health related quality of life among 15 -19 year old adolescents attending public schools in the Gampaha District. A school based descriptive cross sectional study was conducted to assess the Perceived Dental Neglect (PDN), oral health status and Oral Health Related Quality of Life (OHRQoL) among 1332 study participants. Perceived dental neglect and OHRQoL were assessed using the validated PDN and Oral Impact on Daily Performance scales (OIDP modified). The 18 item PDN scale and the 12 item OIDP modified scale used scoring methods based on five point and six point Likert scales, respectively. A significant difference ($p < 0.05$) was observed in number of decayed and missing teeth between low, medium and high PDN groups. A significant difference ($p < 0.01$) was observed in the Calculus Index between low, medium and high PDN groups. Moreover a significant positive correlation was observed between the number of decayed teeth and the PDN score. Significant association could not be obtained between PDN and OHRQoL. The Dental Neglect Scale appears to be a sound method for objectifying dental neglect. It has a significant effect on dental caries and oral hygiene. Having identified the high risk group for dental neglect by using the valid and reliable PDN scale, interventions could be implemented in order to achieve primary prevention. Even though PDN has no significant effects on OHRQoL, having identified the high oral impact group for daily performance by the valid and reliable OIDP-modified scale, interventions could be implemented to achieve secondary and tertiary prevention, by offering needed dental treatment to the affected participants.

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104/A

Anticancer effects of *Plumeria rubra* in HER2 positive breast cancer cell lines

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Natural products have been used for centuries in the treatment of many diseases, and plants in particular have been heavily used for this purpose all over the world including in Sri Lanka. The chemical diversity of plants has played significant roles in drug discovery. Cancer has been a global burden and the search for novel drugs is yet a priority aim for cancer therapy due to the resistance mechanisms and high toxicity associated with current cancer chemotherapy drugs. Thus, it is important to discover and identify novel molecules from plants that will help to discover pharmaceutical agents for combating cancer. At present, around 50% of drugs used in cancer chemotherapy are natural-product derived. Previous research has shown that certain plant species in the Apocynaceae family possess anticancer activities. Therefore, the anticancer effect of leaves and stems of *Plumeria rubra*, which belongs to this family, was investigated. The ethanol extracts were prepared from dried leaves and stems. It was found that the leaf extract inhibits the growth of breast cancer cell lines, especially HER2 positive SKBR3 cells, by MTT assay ($GI_{50} = 17.45 \mu\text{g/ml} \pm 2.05$). MTT assays were used to investigate the *in vitro* growth inhibitory effects of the plant extracts on cancer cell lines. However, the stem extract was not active in the cancer cell lines tested compared to the leaf extract. Thus, further investigations were carried out to determine the mechanism of the *Plumeria rubra* leaf extract. It was found that the 2x GI_{50} concentration of the leaf extract completely inhibited SKBR3 colony formation in the clonogenic assay ($p < 0.0001$). The clonogenic assay was used to investigate whether single cancer cells are able to survive the challenge of the plant extracts and retain proliferative capacity to form progeny colonies. Subsequently, cell cycle assay was used to measure the percentage of cellular accumulation at a particular phase of the cell cycle in the presence of the plant extract. Interestingly, the leaf extract was also able to block the G1 phase in SKBR3 cells (84%) compared to untreated cells (75%) ($p < 0.0001$). Apoptosis assays provides an estimate of viable cells and apoptotic cells, after treatment with the plant extract, as such a significant apoptotic population was also observed in SKBR3 cells that were treated with the leaf extract (7%), compared to control cells (3%) ($p < 0.0001$). This agent was able to cause a minor amount of DNA double strand breaks by gamma H2AX analysis in SKBR3 cells ($P < 0.05$). There is evidence indicating that reactive oxygen species can act as cancer suppressors. As such, it was found that the leaf extract was able to generate high levels of reactive oxygen species compared to SKBR3 control cells ($P < 0.001$). All experiments were repeated ≥ 3 times and Graphpad Prism 7.0 was used for analysis. These results are promising and further studies will be conducted to isolate chemical compounds from this plant species for cancer therapy.



105/A

Effect of vascular endothelial growth factor 165a on initiation of porcine primordial follicle development under the short-term culture system

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Mammalian folliculogenesis is a complex process, which determines the availability of viable oocyte for successful fertilization. Initiation of mammalian primordial follicle development is poorly understood. Vascular endothelial growth factor 165a (VEGFA165a) is a well-known angiogenic factor, which stimulate the vascular bed formation under excess androgen conditions in cows with cystic ovarian lesions. Therefore, studies on the role of VEGFA in ovarian follicle activation are indispensable. The objective of the current study was to determine the effect of VEGF165a on porcine primordial follicle development *in vitro*. This preliminary data was obtained from short-term (72 hours) *in vitro* culture of porcine ovarian cortical stripes under 5% CO₂, with humidified atmospheric conditions. The effect of three different VEGFA165a dose regimes (0.1ng/ml, 1ng/ml and 10ng/ml) was tested. The lowest dose regime (0.1ng/ml) showed the highest viable follicle counts, compared to the 1ng/ml or 10ng/ml regimes. Accelerated follicle degeneration was shown under the dose regime of 10ng/ml. This study provides evidence for the effect of low VEGFA165a concentrations on follicle viability in porcine tissues under short term culture conditions even though the results were not statistically significant ($p>0.05$). In conclusion, it is evident in this study that the lowest concentrations of VEGF165a has increased the follicle viability while higher concentrations implicitly increased follicle degeneration.

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106/A

Leishmaniasis trend and effects of climatic factors in the Polpithigama Medical Officer of Health area in Kurunegala district, Sri Lanka

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Climatic variability has been shown to affect the occurrence vector borne diseases such as Malaria and Dengue in Sri Lanka, and studies in other countries suggest that leishmaniasis is highly influenced by climatic variables. Since there are very limited published studies on the effects of climatic factors on leishmaniasis incidence in Sri Lanka, a study of this nature, addressing the effects of climatic variables on the trend of the disease is very important. Records of patients who were confirmed positive for leishmaniasis and reported by hospitals to the Polpithigama MOH office from January 2013 to December 2016 (48 months) were obtained. Selected climatic data were also acquired from the Department of Meteorology. A total of 56 patients were identified from this MOH area during the above four years. All these cases were of cutaneous origin. The majority (67.86%; n=38) of the patients were from Pansiyagama PHI region, a rural area with chena cultivation being the popular livelihood, followed by Polpithigama PHI region (16.07%; n=9). Results revealed that 59% (n=33) of the infected individuals were males while 41% (n = 23) were females. From the affected group, the majority are in the 46-60 age group (29%; n=16) followed by 31-45 (23%; n=13) and 16-30 (21%; n=12) age groups. The annual incidence pattern was not auto-correlated at any lag period as shown by the autocorrelation function. It is evident that there is no seasonality in the disease occurrence as suggested by the box plot diagram and time series plot. The stable seasonality test also indicates the absence of an identifiable seasonality at the 5% significance level ($F_5 = 0.483$; $df = 11$; $p > 0.05$). Interestingly, a moderately strong correlation was detected between the number of patients and the rainfall, having three month lag period ($r = 0.430$, $p < 0.005$). This may be due to the fact that rainfall may enhance conditions suitable for larval habitation and adult survival. Other climatic variables did not show any correlation. Regression analysis shows that the changes in rainfall significantly predict the change of the number of disease incidence ($F = 9.76$; $p < 0.005$), however, rainfall accounted only for 18.5% of the variability of the number of patients after three months' lag.

Keywords: Leishmaniasis, climatic, patients, disease.

Acknowledgement: National Research Council, Sri Lanka (Grant No. NRC 16-142).

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107/A

The clinico-epidemiological and diagnostic patterns of malaria in transition – experience from Sri Lanka 2015-2016

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Sri Lanka, previously recognized to be an endemic territory for malaria, has now reached the prevention of reintroduction phase. This has led to a transition in the clinic-epidemiological characteristics, patterns of diagnosis and parasitic species causing malaria in the country. When a malaria positive patient was reported to the Anti Malaria Campaign Headquarters during the years 2015 and 2016, the patient was visited and clinical and epidemiological data relevant to the infection was collected using a pretested, interviewer administered questionnaire. Information was also collected from the Bed Head Ticket. The objective of this study was to determine the changes in clinical presentation and epidemiological patterns, which will be useful in improving malaria surveillance. A total of 77 imported malaria cases were reported during this period. Over 86% were males 21-50 years of age. *Plasmodium falciparum* (n=35) was the predominant species detected, followed by *P. vivax* (n=33), *P. ovale* (n=7) and *P. malariae* (n= 1), and, in addition, the only case of *P. knowlesi* reported from Sri Lanka. The majority of infections were diagnosed in the private sector (31/77; 40%) and passive case detection due to clinicians' referral was the main mode of diagnosis (55/77; 71.4%). Seven cases were identified by active case detection amongst high-risk groups while eight cases were detected accidentally on examination of a blood picture without a referral for a malaria test. Fever with chills and rigors was the most common presentation and fifteen patients developed severe malaria. Most of the infections were diagnosed in Sri Lankans (70.1%, n=54) arriving from African destinations (38/54; 70.3%). Amongst foreign nationals, the majority were Indians (14/23; 60.9%). The majority of cases were residents of the Western Province (62%). The percentage of cases diagnosed in the Western Province was 74%, while at least one case was reported from seven out of the other eight Provinces. The time taken for diagnosis ranged from 0-54 days (this includes the duration from the day of onset of symptom till diagnosis in patients who developed symptoms after disembarkation in Sri Lanka or duration from date of arrival to diagnosis in patients whose symptoms started abroad) with a mean of 7.42 (± 8.67) days. Due to the current rarity of malaria in Sri Lanka, it is not considered in the differential diagnosis of patients presenting with fever, resulting in a delay in diagnosis. The patients were treated according to the national malaria treatment guidelines. Enhanced surveillance (both active and passive) and high vigilance, especially in the Western Province, are very important in keeping Sri Lanka malaria free.

Acknowledgement: Financial assistance from the National Science Foundation (Grant No: RG/2014/HS/03) is gratefully acknowledged.



108/A

Determination of variant and Insecticide resistance status in *Anopheles stephensi* Liston in Mannar: a threat for prevention of reintroduction of malaria into Sri Lanka

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Anopheles stephensi, the urban malaria vector in India, has been recorded from Mannar Island, Sri Lanka in early 2017. For the elimination of this species from its newly invaded territory, it was crucial to determine the variant of the species and the susceptibility status of the population to the potential insecticides used in larviciding and Indoor Residual Spraying (IRS) in malaria vector control. With these objectives a field laboratory was set up in Pesalai, Mannar and a temporary colony of *Anopheles stephensi* was established. To determine the variant of the species present, the eggs (n=397) of the F1 generation were observed under microscope and the number of ridges present in egg float was recorded. Susceptibility of larvae and adult females to insecticides was tested using standard WHO test kits and procedures. The larvae (L3 & early L4 stages) collected from the breeding sites, mainly wells, were exposed to discriminating concentration of Temephos 0.25 mg/l. For this test, 150 larvae were used at a time in 4 test replicates and 2 controls. This was repeated three times from February to April 2017. Adult females (2-5 days old, unfed) obtained from rearing larvae in the laboratory were exposed to discriminating concentrations of several insecticides belonging to three classes. The tested insecticides were Cyfluthrin 0.15%, Deltamethrin 0.05%, Lamdacyhalothrin 0.05%, Etofenprox 0.5%, Propoxure 0.1%, and Malathion 4%. The test mortalities were adjusted for control mortalities using Abbots formula. The mode and the mean number of ridges in the egg float was 19 and 18.5 ± 1.3 (Mean \pm SE). Percentage mortalities in larval susceptibility test for Temephos were 95%, 91% and 87% in three consecutive months. The adult *An. stephensi* showed mortalities 12%, 54%, 37%, 72%, 75% and 56% for Cyfluthrin 0.15%, Deltamethrin 0.05%, Lamdacyhalothrin 0.05%, Etofenprox 0.5%, Propoxure 0.1%, and Malathion, 4% respectively. *An. stephensi* population present in Mannar was identified as Type form based on the number of ridges. Larvae showed possible resistance to Temephos and the adult females were resistant to all the insecticides tested. The findings indicate that the control of *An. stephensi* population in Mannar Island is a challenge due to its resistance to insecticides. The presence of Type form which is the variant with high vectorial capacity and occurring mostly in urban areas in other countries shows the high risk of reintroduction of malaria into the country.

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109/A

Breeding habitat preference and man biting habit of *Anopheles stephensi* in Island of Mannar in Sri Lanka

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Anopheles stephensi was recorded from the island of Mannar in the Northern Province in December 2016 for the first time in Sri Lanka. This mosquito species is an urban vector of malaria in neighboring countries and breeds predominantly in man-made container type habitats. Being an urban vector, appearance of *An. stephensi* in Sri Lanka has posed the newest challenge to the attempts taken to keep the country malaria free. Therefore, this longitudinal study was carried out in the island of Mannar to explore the breeding site preference and human biting behavior of *An. stephensi*. Entomological surveys were carried out in the period from December 2016 to May 2017 and a total of 1339 potential mosquito breeding sites has been sampled in six sampling zones located in island of Mannar. Of these sampled breeding sites, *An. stephensi* larvae were found to be primarily breeding in wells (97.6%, n=203). Other identified breeding sources are water storage barrels (1.4%, n=3), cement tanks (0.5%, n=1) and ponds (0.5%, n=1). A total of 2606 *An. stephensi* larvae has been found with highest mean larval density recorded in the month of May in 2017 (24 larvae per 100 dips). The full night human landing catches revealed outdoor man biting (0.26 bites per man per hour) was significantly higher than ($p < 0.05$) indoor man biting (0.027 bites per man per hour). Peak biting was observed in 19 00 to 20 00 hours. According to the findings of this study, the nature of *An. stephensi* breeding in medium to large size man-made confined breeding habitats and outdoor human biting behaviour has posed the newest challenge to the current entomological monitoring and response system of malaria vectors in the country. Hence, in the process of eliminating *An. stephensi* from Sri Lanka, more emphasis should be given to the larval control activities mainly targeting wells. In adult control efforts outdoor vector control interventions should be targeted in the peak biting time considering the outdoor human habits of the local population in the island of Mannar.

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110/A

Predatory efficacy of *Mesocyclops* and *Cyclops* Copepods on *Aedes aegypti* and *Aedes albopictus* larvae under laboratory settings

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As the most challenging health issue in Sri Lanka, dengue remains unchallenged, recording the most severe epidemic of 154,311 suspected cases from January to 21st of September, 2017. With the limitations in conventional vector controlling approaches such as systemic use of insecticides, novel methods are needed to manage low densities of dengue vectors, *Aedes aegypti* and *Ae. albopictus*. Copepods are considered as a leading predator in many aquatic ecosystems and have been used effectively as biological controlling agents, in successful attempts to control *Aedes* mosquito larvae. The current study attempts to determine the predatory efficacy of three copepod species, viz, *Mesocyclops scirassus*, *Cyclops varicans*, and *C. languides* under laboratory conditions. Copepods were collected from pre-identified locations in the Kandy district, and were cultured under laboratory conditions by providing *Paramecium* culture and wheat grain as supplementary food. Groups of 200 *Ae. aegypti* larvae (1st instar) were introduced into containers with 5 adult copepods of individual copepod species in three different containers, and the number of remaining larvae were enumerated at 3 hour intervals within a duration of 24 hours. The same methodology was followed with *Ae. albopictus* and for each *Aedes* species, five replicates were conducted. The average number of larvae consumed by a single copepod was calculated for each copepod species and General Linear Modelling technique (GLM) followed by Tukey's pair-wise comparison was used to identify the effectiveness of copepod species for controlling of *Aedes* larvae. All statistical analyses were performed in SPSS (version 23). The predatory efficacy of copepods varied significantly, in terms of both copepod species ($p=0.01$) and larval species ($p=0.04$) at the 5% level of significance. Consuming 31 and 29 larvae of *Ae. aegypti* and *Ae. albopictus*, respectively (within 24 hours), *M. scirassus* displayed the highest predacious efficiency. Meanwhile, *C. languides* had the lowest predatory efficacy of 11 and 9 larvae of *Ae. aegypti* and *Ae. albopictus* within 24 hours. Based on the findings, both *M. scirassus* and *C. varicans* could be recommended as potential candidates for biological controlling of *Aedes* vectors in Sri Lanka. Further studies on the predatory efficacy of the above copepods could be suggested under semi field and field settings.

Keywords: Dengue, copepods, biological control

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111/A

Applicability of malaria rapid diagnostic tests in diagnosing non-falciparum malaria infections in Sri Lanka under zero indigenous malaria setting

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With the renewed global interest in the elimination of malaria, and the World Health Organization recommendation of malaria case management based on parasite diagnosis in all cases, the number of rapid diagnostic tests (RDT) available and the scale of their use have increased rapidly. As Sri Lanka is trying to maintain its “malaria-free” status since certified by the WHO in 2016, it is mandatory that the diagnostic strategy should be able to detect all imported malaria cases and species. The operational characteristic of RDTs varies under different disease endemic conditions. The WHO’s results of the RDT product testing, shows that the detection rate is higher for *P. falciparum*, compared to *P. vivax*, while other parasite species were not evaluated. Hence, the efficacy of the RDT used in Sri Lanka under zero indigenous malaria setting in detecting non-falciparum malaria infections was evaluated. From 245 suspected malaria patients referred to the Anti Malaria Campaign Headquarters, Carestart™ malaria histidine-rich protein 2/ *Plasmodium* lactate dehydrogenase (HRP2/pLDH;Pf/PAN) Combo Test, (index test) and microscopy and nPCR (reference tests) were performed in a blind manner, using capillary whole blood. Sensitivity, specificity and predictive values of RDTs were compared with reference tests. Malaria negative patients were considered as negative controls. The age range of the study participants was 1- 73 years. The majority were males (78%), while 96% had a recent visit to a malaria endemic country. Sensitivity and specificity of RDT in detecting *P. vivax* infections was 98.04%(95%CI 89.55, 99.95) and 99.48%(95%CI 97.16, 99.99) respectively. Positive and negative predictive values were 98.04%(95%CI 87.62, 99.72) and 99.48%(95%CI 96.52, 99.93) respectively. Positive and negative likelihood ratios were 190.2(26.92-1343.97) and 0.02(0.00-0.14) respectively. Sensitivity of RDT in detecting other non-falciparum malaria species was 54.55%(95%CI 23.38, 83.25) while specificity was 100% (CI=98.44-100). Positive and negative predictive values were 100% and 97.91%(95%CI 96.08,98.89) respectively. Negative likelihood ratio was 0.45(CI=0.24,0.87). The unacceptable low sensitivity of RDT for *P.ovale* and *P.malariae* should be considered when using this RDT as a point of care test whenever microscopy facilities are not available. It is recommended that RDTs are used in conjunction with microscopy and not as a substitute.

Acknowledgement: This work was assisted by Anti Malaria Campaign, GFATM and National Science Foundation (Grant No. RG/2014/HS/03).



Section B

201/B

A new device for demarcating furrow lines for sugarcane cultivation on undulating terrain

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Furrowing at a 1% slope has been recommended for planting sugarcane in Sri Lanka for improving irrigation efficiency and controlling soil erosion in sloppy lands. Furrows are constructed according to a horizontal baseline demarcated using a dumpy level, auto level, or a theodolite, keeping a uniform slope along the line. However, this method is not adopted properly by farmers, as it needs skill for handling levelling instruments, in addition to time consumption. Non-availability and/or expensiveness of necessary levelling instruments are other great limitations. Therefore, a simple, efficient, and inexpensive levelling instrument is required to popularise the correct furrowing method among sugarcane farmers in Sri Lanka. As such, a device for demarcating furrow lines in sugarcane lands was designed and fabricated using locally available low-cost materials. The total material cost of this new device was Rs 2,200 at the prices prevailing in the year 2016.

The pressure at equal levels of a fluid is the same if the system is open, and the pressure depends only on the vertical height difference between the base and the fluid surface. This principle was applied to design this furrow-demarcating device, with some modifications according to the specific requirements of sugarcane farming. The newly developed furrow linedemarcating device consists of three main parts, *i.e.*, a transparent plastic tube, an air relief valve, and an adjustable scale.

The newly developed furrow linedemarcating device was evaluated and compared with the performance of the dumpy level which is currently used for furrow line demarcating in sugarcane fields in Sri Lanka. Three different farmer fields situated in undulating terrain at UdaWalawe and Sevanagala were selected for testing the accuracy of the device and the labour efficiency. The results of field evaluation confirmed that the new device has sufficient accuracy for furrow line demarcating, compared to the dumpy level. The detected error for horizontal and vertical axes were 15.9 ± 2.7 cm and 0.67 ± 0.16 cm, respectively. These errors were negligible when compared with the furrow spacing recommended for sugarcane, which is about 137 cm and the furrow depth is about 25 cm respectively. Moreover, the use of the newly developed furrow linedemarcating device increases the efficiency of labour by nearly 20% compared to the dumpy level.

Keywords: Contour Farming, Furrow Construction, Sugarcane, Sri Lanka



202/B

Residual effect of applied organic manure on crop performance of coconut

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Organic coconut cultivation has rapidly gained popularity due to many advantages including the premium price paid for the products and increasing demand for fresh and processed products in the world market. Although there are numerous advantages of organic cultivation of coconut, continuous supply of nutrient through organic manure is still challenging due to lack of availability of required input material. Therefore, growers tend to apply organic manure from time to time depending on availability of manure. However, changes in palm nutritional status and nut yield of coconut after discontinuation of organic manure application are not well understood. Therefore, this study is aimed at assessing the residual effect of applied organic manure, compared with green manure and conventional fertilizer. A field experiment was carried out on coconut, on a long-term (10year) basis, with three organic manures applied as separate treatments, namely, goat manure, cattle manure, and poultry manure, as well as a green manure (*Gliricidia*), against conventional fertilizer (adult palm mixture). After termination of manure and fertilizer application, palm nutritional levels and nut yields were evaluated for all five treatments up to five years.

Index leaf nutrient levels as an indicator of palm nutritional status shows that three years after termination of manure application, only potassium was below the critical levels in control and conventional fertilizer treated palms (0.72% and 0.95%, respectively) while organic manure treated palms had all major nutrients (N, P, K and Mg) at sufficient levels. However, by 5 years after termination of nutrient supply from fertilizer/manure, nitrogen and potassium, the two major essential nutrients had dropped below the critical levels irrespective of the treatments. Nut yield shows that the poultry manure applied treatment has given significantly higher ($P < 0.05$) nut yield up to four years after stopping manure application while control treatment (no fertilizer) gave the lowest nut yield throughout the experimental period. After termination of fertilizer application there was a declining trend in yield of all treatments. However, the rate of yield decline has been lower in organic manure applied treatments compared to conventional fertilizer applied treatments. It indicates that manure applied palms have resilience to hindered supply of nutrients even five years after termination of manure application.

Keywords: Organic Coconut; residual effect; organic manure

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203/B

The role of gender in perceiving societal damage of a product harm crisis: Special reference to Sri Lankan young consumers

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The main purpose of the current study is to uncover how gender shapes young consumers' perceptions relating to the societal damage of product harm crises. The study used a convenient sample of Sri Lankan based undergraduate marketing and business management students (n=53). A culpable product harm crisis scenario involving a fictitious company, regarding a fictitious brand of yoghurt, was used in the study. A self-administered, pre-tested questionnaire survey was conducted. An independent samples *t* test was run to analyze the data. The study revealed that gender significantly shapes how a consumer perceives societal damage resulting from a product harm crisis. Females perceive higher societal damage than their male counterparts, revealing the gender difference in their perceptions. This research has important theoretical and managerial implications for researchers, marketers and policy marketers in product harm crises.

Keywords: Product harm crisis, societal damage, Sri Lanka, company culpable



204/B

Evaluation of energy and mechanical properties of biomass briquettes produced with invasive *Eichornia crassipes* (Water hyacinth), wood residues and cow dung.

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Water hyacinth is an aggressive invasive species spread over 45% of fresh water bodies in Sri Lanka, and has considerable energy within. This study aims to identify the ideal proportion of the sawdust : water hyacinth and cow dung : water hyacinth ratios needed to produce briquettes for biomass boilers in industries. Raw materials were pre-processed to obtain 1-3mm particle size after drying, grinding and sieving. Pre-processed water hyacinth was mixed with sawdust in 25:75 (S1), 50:50 (S2) and 75:25 (S3) proportions and with cow dung in 25:75 (C1), 50:50 (C2) and 75:25 (C3) proportions. Briquettes were produced using screw type extruder briquetting technology and energy properties including moisture content, volatile matter content, ash content, fixed carbon, and calorific value, and mechanical properties including bulk density, compressed density, relaxed density, durability, water resistance capacity, and water boiling time were measured and fuel wood value indices (FVI) of briquettes were calculated. Three replicates were tested and the results were analyzed using one way ANOVA followed by Tukey's pair wise comparison. In sawdust - water hyacinth briquettes, there is no significant difference between three types for FVI and density. The S2 type has a significantly higher calorific value (19.17 kJ/g) and water resistance capacity (98.73%) and significantly lower moisture content (5.32%) and water boiling time (10 minutes). In cow dung - water hyacinth briquettes, the C2 type has a significantly higher FVI and volatile matter content (75.54%) and significantly lower moisture content (5.81%) and fixed carbon content (10.0%). Briquettes performance will be improved further if the screw type briquetting machine is modified to water hyacinth materials. In this study sawdust - water hyacinth briquettes S2 and in cow dung - water hyacinth briquettes C2 types are performing better. Biomass briquettes will contribute to fulfil energy requirements demanded by industries, as well as helping to control the growth of water hyacinth.

Keywords: Renewable energy, Water hyacinth, Biomass briquettes

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205/B

Comparison of existing *Phyllanthus* populations by means of phytochemical contents and its bioactivity

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Phyllanthus debilis Klein ex Willd (Euphorbiaceae), also known as "Pitawakka" in Sinhala, is therapeutically important medicinal plant widely used in traditional and ayurveda systems of medicine for the treatment of jaundice, sickle-cell anemia, diarrhoea, wounds, inflammation, intestinal worms, scabies, ring worm, gall stones and kidney stones in Sri Lanka and other Asian countries.

Eventhough, morphologically different populations exist in different agroclimatic regions in Sri Lanka, all are considered to be *Phyllanthus debilis*, and hence authentication of existing populations is a timely requirement. Therefore, the present study was carried out to compare the existing *Phyllanthus debilis* populations by means of total phenol content (TPC), total flavonoid content (TFC), and total antioxidant capacity (TAC) of different parts (leaf, stem and root). TPC, TFC, and TAC were determined using the Folin-Ciocalteu method, the colorimetric method developed by Liu *et al.*, 2002, and the Ferric Reducing Antioxidant Power Assay (FRAP) method, respectively. The present study indicated the presence of tested phytochemicals (TPC, TFC, and TAC) in all three parts (leaf, stem, root,) of all tested populations of *Phyllanthus debilis*. Significantly higher TAC and TPC were reported in leaf extracts of Red-green and Red populations, respectively. However, significantly higher TFC content was reported from roots of White populations. The present study investigated Total Antioxidant Capacity (TAC), Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) of different parts of selected *Phyllanthus* population for the first time in Sri Lanka. Correlations with strong significance were observed between TAC and tested secondary metabolites, TPC ($R^2=0.989$) and TFC ($R^2=0.989$).

Keywords: *Phyllanthus debilis*, Euphorbaceae, Antioxidant capacity, Flavonoids, Phenolic

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206/B

Determination of photosynthetic biomass gain rate by leaves of selected plant species at their early growth stages

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With the present interest in global climate change mitigation, agro forestry plays an important role in carbon sequestration and carbon trading. Analog forestry is a system of farm based environmental restoration and promising management technology to help obtain photosynthetic biomass. Belipola Analog forest and home gardens at Mirahawatta, Welimada, in the Badulla district were selected as the study sites. Four highly abundant utility tree species, *Artocarpus heterophyllus*, *Toona celiata*, *Persea americana*, and *Mangifera indica* were selected. Purposive sampling was carried out and more than 40% of shaded trees were avoided. From each species 10 individuals from each age group were selected. Leaf samples were collected and total tree height, crown height, and light intensity values were measured. Fresh weight, leaf area and moisture content were measured from the collected leaves. The carbon content in the sampled leaves was measured by the loss-on-ignition method and aggregating that value to estimate the carbon content in the leaves of the crown. Simple linear regression in MINITAB 14 was used in developing relationships between dependent variables (photosynthetic biomass, leaf carbon content) and independent variables (age, tree height, crown height, and moisture content in leaves). The results indicated that the photosynthetic biomass of the early growth stage of four utility trees were significantly increased with the age and showed exponential growth after Age 3. Highest and lowest biomass accumulation rate were given by the *Mangifera indica* and *Toona celiata* species respectively. Photosynthetic biomass showed a significant increase with the leaf area, tree height and crown height; from that *Persea americana* showed the highest rate of increment. The results also indicated that the carbon content of the leaves of the four selected utility tree species in the early growth stage are between 20% and 22%, and showed a significant increase of Carbon content in leaves with the tree height, crown height, and leaf area. With the leaf area *Artocarpus heterophyllus* showed lower Carbon accumulation in leaves, while other 3 species showing a high, more or less equal rate of increment. With the tree height *Artocarpus heterophyllus* and *Toona celiata* species showed highest rate of increment. Trees are not given the actual value from the services they provide. Photosynthetic biomass in terrestrial ecosystems are largely composed of leaves, this component needs a value placed on it for its 'environmental services.'

Key words: Analog Forestry, Photosynthetic biomass, Carbon accumulation

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207/B

Analysis of genetic diversity of cabbage head rot fungus, *Sclerotinia sclerotiorum*, by mycelial compatibility groups

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Cabbage head rot caused by an ascomycete fungus, *Sclerotinia sclerotiorum*, is a severe problem in cabbage growing areas worldwide. The pathogen is well studied in other countries in terms of its etiology and genetic diversity. Genetic diversity is often measured using Mycelial Compatible Grouping (MCG), which is a phenotypic marker controlled by several genes. No research has been done to assess the population variation of the pathogen in Sri Lanka regardless of the fact that the disease is wide spread in cabbage growing areas. The objectives of the current study were to examine genetic diversity of *Sclerotinia* population from upcountry cabbage fields in Sri Lanka using MCGs, and to determine if the disease is spread through clonal infections from the infection foci. It was hypothesized that the pathogen population in Sri Lanka is relatively diverse and when a plant gets infected, nearby infections occur clonally via mycelial infection. If more than one MCG is found in each infection focus it is clear that more than a single infection causes the disease. Isolates were paired in all possible combinations in potato dextrose agar plates amended with red food colouring and barrage formation was observed. Isolates were considered as mycelially compatible if no barrage formation was observed. Nine MCGs were obtained in a population of 42 isolates. The largest MCG consisted of 14 isolates. Many MCGs (56%) had only a single isolate. Based on the results, the Sri Lankan pathogen population was moderately diverse in terms of MCGs. To determine if the disease spreads clonally or not, three infection foci were selected. At least 10 sclerotia from each cabbage head of each infection focus were collected and isolates were obtained. All the isolates within each infection focus were paired in all possible combinations to determine their MCGs. All of the isolates were compatible in all possible combinations in one infection focus. Interestingly, in the second infection focus, two MCGs were found within a single cabbage head. All the other isolates were compatible among themselves. This indicates that multiple infections result in the cabbage head rot. Multiple infections could be due to ascospore infections or introduction of multiple genotypes to the population via seed lots or other means. Relatively high MCG diversity and multiple infections indicate that there is a risk of a *Sclerotinia* epidemic in the Sri Lankan vegetable cultivation system.

Keywords: Cabbage head rot, MCGs, *Sclerotinia sclerotiorum*.

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208/B

***In Silico* Analysis of salt tolerance associated gene OsHKT8 in Sri Lankan rice accessions.**

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Rice (*Oryza sativa*) is rated as a salinity sensitive crop since all stages of growth and development could be affected by salinity. Although there are traditional cultivars naturally tolerant to salinity stress they generally lack preferred agronomic characteristics. Therefore, identifying salinity tolerant genes in traditional varieties and incorporating them into agronomically favourable varieties could be a promising approach to produce salinity tolerant rice varieties. Sodium ion transport processes play major roles in the context of salinity stress and tolerance responses. In rice, it is evident that members of HKT (High Affinity K⁺ Transporters) gene family of Na⁺ and Na⁺/K⁺ transporters are important for controlling Na⁺ accumulation in the cells, thus improving salinity tolerance. The OsHKT8 gene is located on chromosome 1 at the position from 11458956bp to 11463442bp producing a gene 3985bp in size. Using the sequence information of HKT8 of Nipponbare, as the reference rice genome and FL478, as the highest saline tolerant improved rice variety, the rice varieties of Sri Lankan origin reported so far have been compared to detect the genetic diversity of OsHKT8 gene. In this study, HKT8 gene of forty-seven Sri Lankan rice varieties were retrieved from the IRRI (International Rice Research Institute) Database. The retrieved HKT8 gene sequences were aligned using Clustal Omega multiple sequence alignment tool. A total of 117 variants were identified comprising of 95 SNPs and 22 INDELS throughout the gene. There are 3 exons in the HKT8 gene, and highest number of SNPs was present on exome 1, while lowest was on exome 2. The variants were mainly present in non-coding regions of HKT8 and only 21 SNPs and 2 INDELS were present on the coding region. It was shown that Podiwee rice variety has the same SNP variations as that of FL478 with substitutions (T→A, C→T, G→C on exon 1, C→G, G→T on exon 2 and A →C on exon 3). According to the phylogenetic tree drawn based on the presence of SNPs and INDELS in HKT8, varieties were grouped into 3 main clusters. FL478 and Nipponbare were separately sub-clustered with certain varieties, while the traditional salinity tolerant variety, Pokkali, had a separate phylogeny from other selected varieties. The sequence comparison of HKT8 gene across Sri Lankan rice varieties has provided useful information for the plant breeders to utilize the favourable alleles of HKT8 towards salinity tolerance.

Keywords: *Oryza sativa*, Salt tolerance, HKT8

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209/B

A comparative investigation on agronomic traits of popularly grown improved and traditional varieties of rice

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Rice is the staple food of Sri Lankans and it is available mainly in different categories such as improved and traditional varieties. Presently, most cultivation (99%) are improved rice varieties, while about 1% of cultivation in the country are the traditional varieties. Since, nowadays, people in the country have an increased interest to consume traditional varieties as a measure to reduce non communicable diseases (NCDs), this study aimed to monitor the growth and yield performance of selected traditional varieties, with comparison to selected improved varieties. Agronomic traits of popularly grown improved (15) and traditional (15) rice varieties were evaluated at Rice Research Station, Ambalantota during the 2016/2107 *mahaseason*. Fourteen day old seedlings were transplanted in experimental plots (8x3m) with 2 replicates to randomized complete block design (RCBD). A quadrat (30x30 cm) was placed randomly in each plot thrice to count the number of plants and tillers at 4, 5, and 6 weeks after transplanting. At flowering, plant height (PH), panicle length and number of seeds per panicle (NSP), and at harvest, total and unfilled seeds per panicle (USP), grain shattering (GS), thousand grain weight (TGW), and plot yield were recorded. Significant differences among rice varieties were observed in PH, panicle length, NSP, GS, USP, TGW and grain yield. All the traditional varieties (PH 112- 174cm) were taller than improved (PH 84 - 107 cm). During grain filling most of the traditional rice varieties logged totally or partially in the field. The longest (28.8 cm) and shortest (20.6 cm) panicles were reported in Bw 272-6B and Ld 408 respectively. NSP was found to be significantly high in 2 improved varieties Bw 367 and Ld 368. With 4 exceptions, the improved varieties have given yields of more than 5 t/ha, while yields were below 5 t/ha in traditional varieties. In conclusion, different agronomic traits have contributed favourably to achieve significantly high grain yield in the improved rice varieties. Although different traditional varieties inherit desirable traits for high yields, plant height accompanied by logging as well as grain shattering and unfilled seeds per panicle had affected the yield badly.

Key words : Agronomic traits, improved, rice, traditional, varieties

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210/B

Isolation and morphological characterization of possible Glyphosate degrading bacteria from selected contaminated sites in Sri Lanka

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The use of synthetic pesticides has become an indispensable tool in Sri Lankan agriculture. The extreme usage of Glyphosate herbicide over the past years in the country has led to serious environmental pollution. Bioremediation is considered as the most environmentally sound technology for the environmental clean-up. The present study was aimed at isolation and morphological characterization of the bacterial species that could potentially utilize Glyphosate as their sole source of carbon and energy. Soil samples were obtained from the selected agricultural lands in Dambulla and Rathnapura, which were chronically contaminated over ten years with numerous pesticides including Glyphosate. The enrichment culture technique was used to isolate bacteria from the collected soil samples by providing Glyphosate at the concentration of 50 ppm in the Mineral Salts Medium (MSM) under the incubation temperature of 30°C for two weeks. Based on their differences in colony morphology, five bacterial species (T1W, T1WF, T2Cr, D1O, and D2T) were isolated that could potentially biodegrade Glyphosate. These bacterial isolates were characterized by culturing on both Nutrient Agar medium and on MSM agar enriched with Glyphosate (50 ppm). Gram staining of isolates characterized T1W and D1O as Gram positive short rods, T1WF as Gram positive cocci, T2Cr as Gram negative cocci, and D2T as Gram negative long rods. In conclusion, the isolated bacteria might possess the ability to utilize Glyphosate as the sole carbon source and they might be used in bioremediation of Glyphosate-contaminated environments. However, molecular characterization would be needed for precise identification of the isolates and further studies would be needed to assess the Glyphosate biodegradation capacities of these isolates.

Keywords: Glyphosate, bioremediation, Mineral Salts Medium, morphology, Gram stain

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211/B

Water stability of aggregates in relation to water-repellent characteristics in an *Eucalyptus* (*Eucalyptus grandis*) forest soil

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Soil water repellency is a phenomenon that reduces the rate of wetting, leading water to remain on the soil surfaces for prolonged periods. It primarily affects the infiltration rates and hydrological balance in soils, which can be related to the slaking and stability of soil aggregates. *Eucalyptus* plantations generally cause water repellency in underlying soils. The aim of this research is to examine the stability of soil aggregates in a *Eucalyptus* plantation forest in upcountry Sri Lanka, in relation to water repellency in soil. Water repellency was measured using the water drop penetration time (WDPT) test in the soil depths of 0–5, 5–10, 10–15, 15–20, and 20–25 cm. Stability of soil aggregates were measured by wet sieving apparatus for 5 min. (1.3 cm stroke; 34 oscillations/min).

The surface layer (0–5 cm) of soil showed the highest WDPT (> 3600 s) showing an extremely repellent level. The 5–10 cm depth was strongly repellent (WDPT = ~100 s), whereas 10–15, 15–20, and 20–25 cm depths were slightly repellent (WDPT = 1–60 s). The percentage of water stable aggregates (%WSA) was highest (88%) in 0–5 cm layer and gradually decreased with increasing soil depth showing strong negative linear correlation ($R^2 = 0.98$). The %WSA of 5–10, 10–15, 15–20 and 20–25 cm soil depths were 86%, 84%, 82%, and 78%, respectively. Decreasing %WSA with increasing soil depth might be related to decreasing soil water repellent conditions, as water repellency reduces wetting of soil aggregates and the pressure build up within aggregates. We observed a strong positive linear correlation ($R^2 = 0.84$) between the %WSA and soil water repellency as given by log WDPT. Although the %WSA was >75% in all tested soil depths, we observed onsite evidence of soil erosion. Water repellent conditions are known to lower the cohesiveness of soils, and to keep the surfaces of soil aggregates dry. This may make small soil aggregates easily detachable even beneath a water film. Water drops hitting the soil might cause detaching of much larger amounts of sediment from hydrophobic soil than from hydrophilic. As the slope of the area is very high, there are possibilities of extreme catastrophic consequences of establishing *Eucalyptus* in this kind of landscape. The experiment was carried out in the wet season. Further studies are required to determine the seasonal pattern of these phenomena.

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Keywords:*Eucalyptus*, water stability of aggregates, soil water repellency, water drop penetration time.

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212/B

Variation of phytochemicals and antioxidant capacity of domesticated and non-domesticated populations of *Momordica charantia* L. (Cucurbitaceae) fruits harvested at different maturity stages

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Momordica charantia L. is a therapeutically important medicinal plant belonging to the family Cucurbitaceae, and is extensively consumed as a vegetable and used as a treatment for an array of diseases in *Ayurveda* and traditional systems of medicine in Sri Lanka. The exerted therapeutic properties of *M. charantia* are mainly due to the presence of an array of bioactive compounds. These bioactive compounds can vary according to the maturity stages of the fruits. Therefore, the present study was undertaken to determine the variation of total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC) of domesticated and non-domesticated populations of *M. charantia* fruits harvested at different maturity stages (Immature, semi-mature, mature, ripe). TPC, TFC and TAC of *Momordica* fruits were determined by the Folin-Ciocalteu method, aluminium nitrate method, and the Ferric Reducing Antioxidant Power Assay, respectively. Results demonstrated the presence of TPC, TFC, and TAC in all maturity stages of fruits of both populations. Significantly the higher TAC, TPC, and TFC contents were observed in immature stages of fruits of both populations. The TPC and TFC were significantly ($P < 0.05$) decreased during fruit maturity. At the ripening stage, the TAC of the domesticated population was decreased up to 3.44 ± 0.05 mg Trolox equivalent/g DW and 2.26 ± 0.29 mg Trolox equivalent/g DW respectively. It could be concluded that immature fruits are more suitable for therapeutic purposes.

Key Words: Cucurbitaceae, *Momordica charantia*, Total antioxidant capacity, Total phenolic content, Total flavonoid content

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**Phytochemical contents and antioxidant capacity of different parts of *Momordica charantia* Linn
(Cucurbitaceae)**

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Momordica charantia Linn is an herbal climber grown in tropical and subtropical regions, belonging to the family Cucurbitaceae. Different parts of *Momordica charantia* are used for the treatments for various diseases, including cholera, bronchitis, anemia, blood diseases, ulcer, diarrhea, dysentery, and gonorrhoea, and as asexual tonic, in *Ayurveda* and traditional systems of medicine in Sri Lanka. However, studies on the therapeutically important active components present in different parts of *Momordica charantia* are scattered or lacking. Therefore, the present study was undertaken to determine the Total Antioxidant Capacity (TAC), Total Phenol Content (TPC) and Total Flavonoid Content (TFC) of different parts (leaf, stem, root, and fruit) of domesticated and undomesticated populations of *Momordica charantia* were collected from Western and North Western provinces in Sri Lanka. The TAC, TPC, and TFC were determined using Ferric Reducing Antioxidant Power Assay (FRAP), modified Folin-Ciocalteu colorimetric method, and aluminium nitrate colorimetric method, respectively. All tested parts of both populations exhibited the presence of TAC, TPC, and TFC. The highest values for all chemical tests of TAC, TPC, and TFC resulted from the leaf extract of both undomesticated (7.8 ± 0.25^a mg Trolox Equivalent / g DW, 7.22 ± 0.33^a mg Gallic Acid Equivalent / g DW and 13.14 ± 0.25^a mg Rutin Equivalent / gDW, respectively) and domesticated (5.51 ± 0.14^b mg Trolox Equivalent / g DW, 7.45 ± 0.54^a mg Gallic Acid Equivalent / g DW and 14.19 ± 1.07^a mg Rutin Equivalent / gDW, respectively) populations. The order of increase was leaf>stem>fruit>root of both *Momordica* populations. It is concluded that presence of biologically active molecules in all parts of the plant demonstrate its future potential in the nutraceutical industry.

Keywords: Cucurbitaceae, *Momordica* populations, Antioxidant capacity, flavonoids, phenolics, plant parts

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Phytochemical distribution and antioxidant capacity of different parts of *Tagetes erecta* Linn (Asteraceae)

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Tagetes erecta Linn species, popularly known as Marigold, belong to family Asteraceae, and is distributed in varied agro climatic zones in different parts of the globe. *Tagetes erecta* is considered as a multipurpose medicinal plant due to its diverse usages in traditional medicine, ornamental industry, and the agricultural sector. Although Marigold is a multipurpose plant, information on presence of secondary metabolites and the distribution of phytochemical and bioactive compounds in the plant parts are scattered. Therefore, the present study was undertaken to determine the Total Phenolic Content (TPC), Total Flavonoid Content, and Total Antioxidant Capacity of different parts (flowers, stems, leaves and roots) of *Tagetes erecta*. The TPC, TFC, and TAC were determined using Ferric Reducing Antioxidant Power Assay (FRAP), modified Folin-Ciocalteu colorimetric method, and a calorimetric method, respectively. All tested parts demonstrated the presence of TPC, TFC, and TAC. A significant higher TPC, TFC, and TAC were found in flowers than in other parts of plant (12.75 ± 0.25^a mg GAE /g DW, 48.81 ± 0.87^a mg RE/g DW and 105.27 ± 5.21^a mg TE/ g DW respectively). The lowest TPC, TFC and TAC were observed in roots (3.50 ± 0.60^d mg GAE /g DW, 8.29 ± 0.29^d mg RE/g DW and 4.98 ± 0.43^c mg TE/ g DW respectively). Strong significant correlations were observed between TAC and tested secondary metabolites (TPC, $R^2=0.989$ and TFC, $R^2=0.989$).

Keywords: *Tagetes erecta*, Asteraceae, Antioxidant capacity, flavonoids, phenolic, plant parts

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**Some agronomical studies and phytochemical analysis of *Stevia rebaudiana* Bertoni –
a natural low calorie sweetener**

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Stevia rebaudiana Bertoni, an ancient perennial herb native to South America, produces glycosides of the diterpene steviol, that are low calorie sweeteners, about 300 times sweeter than sucrose. *Stevia rebaudiana* is widely used as a natural sweetener for the production of candy, sweets, and an array of beverages due to its safety for diabetic patients. Even though, this plant has an immense potential to be used in Sri Lanka, it has not been introduced yet due to various reasons. Therefore, the present study was undertaken to establish agronomic practices and post-harvest aspects, by means of total antioxidant and phytochemical behavior under different light intensity, for the purpose of successful introduction of *Stevia rebaudiana* as a promising new agricultural crop and making thereby a contribution to enhance product development. Propagation trials were conducted with three treatments: open polythene pots with single cutting, closed polythene pot with single cutting, and closed polythene pot with multiple cutting (10/pot), while the cultivation trial was conducted with 3 fertilizer types: organic fertilizer, inorganic fertilizer, and the control. All experiments were conducted in completely randomized block design (CRBD). The data on success rate of propagation, number of leaves, number of shoots, and plant height were recorded at one week intervals. Diurnal variation of phytochemicals of total phenolic content (TPC), total flavonoid content (TFC), and total antioxidant capacity (TAC) were determined using modified Folin-Ciocalteu colorimetric method, calorimetric method, and Ferric Reducing Antioxidant Power Assay (FRAP), respectively. Results revealed that a comparatively higher success percentage of stevia can be obtained from cuttings propagated in a closed polythene propagator, with single cutting in a pot, at 90% success rate. A comparatively higher growth rate was observed in plants treated with organic fertilizer compared to the control. Results on diurnal variation of TPC, TFC and TAC demonstrated that all values are increasing from 6 am to 3 pm and decreasing after 3 pm. Stevia can be successfully propagated by adopting potting system with single cutting/pot and cultivated with organic fertilizer and harvested before 3 pm for a better phytochemical yield.

Keywords: *Stevia rebaudiana*, antioxidant capacity, flavonoids content, phenolic content, growth indicators

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***Aporosa lindleyana* Baill. (Kebella) tea: an alternative to Green tea**

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Camellia sinensis, known as tea, is the most consumed beverage worldwide, and is reported to have numerous health benefits. Compared to *Camellia sinensis* other herbal teas are less investigated for their health benefits to date. *Aporosa lindleyana* Baill. known as kebella in Sinhalese is used as a leafy vegetable in Sri Lanka. The root and bark of this plant is reported to have many bioactivities. However, the leaves of this plant have scarcely been investigated for pharmacological activities, except the antioxidant activity by DPPH mechanism, and anti-inflammatory activity. Therefore, the present study evaluated the antioxidant activity by multiple mechanisms, the sensory properties of the tea brew, and quantified the phytochemicals and proximate composition of the leaves of *A. lindleyana*.

Fresh *A. lindleyana* leaves were collected from a Maharagama home garden, Western Province in Sri Lanka, cleaned, oven dried at 50°C for 6 h, powdered and sieved to obtain 0.8 mm size particles to prepare kebella tea. The tea brew of kebella (2 g in 100 mL of boiled water for 10 minutes) was used to evaluate the antioxidants in terms of total polyphenolic content (TPC, n=6), total flavonoid content (TFC, n=6), and antioxidant properties via the Ferric reducing antioxidant power (FRAP, n=6), 1,1-diphenyl-2-picrylhydrazyl (DPPH, n=4), and 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS, n=4) antioxidant bio assays *in vitro*. The sensory evaluation (appearance, colour, mouthfeel, aroma, flavour and overall acceptability) of *A. lindleyana* tea was carried out using a trained panel with comparison to green tea.

The mean TPC and TFC of tea brew of kebella were 875.3 ±42.0mg Gallic acid equivalents/L and 7.85±0.27 mg Quercetin equivalents/L respectively. The antioxidant activities for FRAP, DPPH and ABTS of tea brew were 1151.5 ± 27.7, 899.1 ±74.7, and 1520.3 ± 95.5mg Trolox Equivalents/L respectively. The leaves contain alkaloids (1.4%), saponins (0.79%), steroids (0.54%), terpenoids, tannins and flavonoids. The proximate composition: moisture, carbohydrate, protein, fat, crude fibre and ash were 12.2%, 49.4%, 13.2%, 1.1%, 16.0%, and 8.1% respectively. Sensory evaluation showed that green tea and kebella tea were not significantly different in terms of mouthfeel, aroma, flavour and overall acceptability. In conclusion, the tea brew of leaves of *A. lindleyana* is highly nutritious and possesses marked antioxidant activities. The kebella tea can compete with green tea in terms of major sensory parameters and it can be used as a potential nutraceutical.

Keywords: *Aporosa lindleyana*, antioxidants, sensory evaluation, proximate analysis



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Assesment of incorporating pineapple bagasse as a raw material in the bakery industry

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The objective of this study was to determine the possibility of using industrial fruit processing by products (FPBP) such as fruit peel, skin, seed or pulp (bagasse) with value addition in the food industry. Among the major fruits used in fruit processing, pineapple has the highest wastage value of 65%, which has a potential to be used for vinegar production and as a source of dietary fiber. Pineapple fruit waste is identified as four types, viz., crown and stem, first peel, second peel, and pulp waste, which is 20%, 35%, 26%, and 19% of average wastage, respectively. This study analyzes the value of using pineapple pulp bagasse (PPB) as a dietary fiber source in the food industry. PPB was collected from a selected fruit processing company and dehydrated at 60°C overnight to obtain the dry pineapple pulp powder (PPP) which (425µm, mesh size) had 0.38 water activity. The proximate composition of PPP showed moisture 6.66±0.06%, ash 2.35±0.06%, crude fat 2.49±0.94%, crude protein 4.10±0.01%, dietary fiber 32.53%, and carbohydrate 51.87% on dry basis. The water holding capacity (WHC) and oil holding capacity (OHC) of the prepared flour were 5.14±0.25mL/g and 6.48±0.20 g/g respectively. The soluble dietary fiber fraction mainly determines the hydration property (WHO and OHC) of foods. As value addition to a bakery product, muffins was prepared with different PPP and cake flour ratios (0:100, 5:95, 10:90, 15:85 and 20:80). The 5-10% substitution muffin got the highest preference over 80 untrained panelists. In conclusion, the pulp powder prepared from industrial fruit waste can be combined with soft wheat flour in the bakery industry. Value addition of bakery products simultaneously gives an economically viable application for the industrial fruit waste.

Key words: Industrial Fruit Processing by Products, Pineapple Pulp Powder, Proximate Composition, Dietary Fiber, Food Industry.

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**Impact of gamma irradiation on postharvest shelf life extension of coated giant guava
(*Psidium guajava* L.)**

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Giant guava (*Psidium guajava* L.) has high demand in both local and international markets, and has a limited shelf life of 4 days under normal room conditions. This research was aimed at extending the shelf life by edible coating followed by irradiation at 0 Gy, 100 Gy, 200 Gy, 300 Gy, and 400 Gy doses. A water emulsion with 1% bee's wax, 5.5% sunflower oil, 0.5% Tween 80, and 0.05% of tamarind (*Tamarindus indica*) seed powder was used as a coating. Tamarind seed powder contained 132.06±0.95ppm total polyphenol content, 1.00±0.00% saponin and 3.37±0.00 % alkaloid content, which confirmed its good antioxidative and antimicrobial properties. The shelf life of guava samples was determined by measuring weight loss, color (E value based on L*, a*, b* on the Hunter color scale), breaking point, titrable acidity (TA), pH, total soluble solids (TSS), moisture content and by evaluation for sensory properties. Among the treatments, both coated and non-coated samples irradiated at 100Gy and 200Gy remained acceptable for 16 days. Coated guava samples irradiated at 100 Gy showed 15.66± 0.58% weight loss, 197.4 ±29.0 breaking point, 10.00±0.00 ΔE value, 4.96 ±0.04 pH and, 0.31±0.00% TA on the 16th day, and were significantly better (p<0.05) than other treatments. Coating of guava decreased the moisture loss and shriveling effect while irradiation treatment reduced the respiration process, as the green color of samples existed for 16 days at normal room temperature (29±2°C). The results show that the coated, 100Gy gamma irradiated, giant guava can be kept for more than two weeks with the acceptable freshness at room temperature.

Key words: Giant guava, edible coating, Gamma irradiation, postharvest shelf life extension

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Utilization of pumpkin waste as a source of pectin

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Sri Lanka is a country whose economy is mainly based on agriculture and fruits and vegetables (F&V) are a main sub sector. Annually the country produces around 800,000 metric tons of F&V. However, there is 35-45% wastage of F&V daily at the Dambulla economic center (DEC), which is the main focal point of F&V transactions. Therefore, this study was designed to assess the daily postharvest loss of F&V at DEC and to utilize generated vegetable waste as a source of pectin. Total loss of F&V was estimated through the personal interview method. Daily waste generated at DEC was estimated as 10.8 tons. The vegetables with maximum postharvest losses at the DEC were cucumber (4.84%), pumpkin (4.64%), leeks (3.06%), brinjal (2.96%), tomato (2.85%) and cabbage (2.14%) where the fruits with highest postharvest losses were watermelon (2.65%) and banana (2.25%).

Vegetables with a higher post-harvest loss were screened out for the extraction of pectin. Pumpkin (*Curcubita maxima*) was selected for the extraction of pectin as it has reported a higher postharvest loss (4.64%). Pectin was extracted by the method of acid hydrolysis. The yield of pectin from pumpkin ranged from 7.30 ± 0.07 – 11.04 ± 0.01 % on dry weight basis. In addition, physiochemical and functional properties of pectin were evaluated, and the suitability of extracted pectin for the processing of jam was evaluated. Water holding capacity, oil holding capacity and emulsifying activity index of the extracted pectin were 2.5 ± 0.46 g/g, 1.76 ± 0.10 g/g and 0.29 ± 0.01 respectively. Moreover, the degree of esterification, equivalent weight, methoxy content and galacturonic acid content of the extracted pectin were $67.64 \pm 0.89\%$, 978.4 ± 69.9 , $6.55 \pm 0.37\%$ and $66.46 \pm 1.19\%$, respectively. Sensory analysis revealed that there is no significant difference in textural properties such as spreadability, surface texture and chewiness of two types of jam prepared using pumpkin and commercial pectin. Pectin extracted from pumpkin can be categorized as high methoxy pectin and there is a great potential to use vegetable waste for value addition.

Keywords: Pectin, postharvest loss, acid hydrolysis



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Development of a flake mix using legumes with high total dietary fiber, resistant starch and low glycemic index

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Consumption of dietary fiber rich food has shown many health benefits against a range of disorders including obesity, type 2 diabetes mellitus and colon cancer. Dietary fiber is composed of soluble dietary fiber (SDF) and insoluble dietary fiber (IDF). Legumes are rich source of total dietary fiber (TDF) and resistant starch (RS). Hence, legume starch has low predicted glycemic index (pGI). This study was carried out to develop dietary fiber rich multi legume flake mix with low predicted glycemic index from selected locally available legume varieties. Accordingly, 11 legume varieties – mung bean (MI 5, MI 6), Cowpea (Waruni, MICP1, Bombay, Dhawala ANKCP1), soybean (PB1, MISB1) and horse gram (ANK black, ANK brown) – were analyzed for TDF, RS and pGI content.

The multi-legume flake mix was prepared in 3 different formulae (F1, F2, and F3) by using sorghum (50%) as the base. Different legume proportions of soybean, horse gram, cowpea, and mung bean in those formulae were F1 - 5%, 20%, 15%, 10%, F2 - 10%, 5%, 15%, 20%, and F3 - 5%, 15%, 20%, 10%, respectively. Sensory evaluation was carried out with 3 flavors; coconut milk + spices, coconut milk + sugar, milk powder + sugar for F1 formula. The taste, mouth feel and overall acceptability of flake mix with the coconut milk + spicy flavor was identified as the significantly ($p < 0.05$) superior. Subsequently, those three formulae were prepared in coconut milk + spicy flavor and those were analyzed for TDF, RS and pGI value. Among 3 formulae, F1 has the highest TDF %13.84(SD 0.08), highest RS %4.07(SD 4.07) and the lowest pGI 33.52(SD 0.11). Hence, the F1 formulation can be considered as the best formula for the preparation of a dietary fiber rich multi-legume flake mix.

Keywords: Predicted Glycemic Index, resistant starch, total dietary fiber

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Antioxidant properties of black plum (*Syzygium cumini*) fruits and their processed products

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The fruits of *Syzygium cumini* (L.) Skeels, also known as black plum or madan, which is native to Sri Lanka, have not been much exploited, although they have characteristics similar to blueberry, which is a rich source of natural antioxidants. Thus, this study was carried out to examine the content of some bioactive compounds and the antioxidant properties of fresh black plum fruits. Furthermore, the effect of processing (drying and juice preparation) on bioactive compounds and antioxidant properties of black plum fruits was assessed. Methanolic extracts of fresh black plum fruits, dried fruits, and juice were analyzed for total phenolics, flavonoids, anthocyanin, β -carotene, and ascorbic acid contents, and were evaluated for total antioxidant capacity, lipid peroxidation inhibition, ABTS radical scavenging, and hydroxyl radical scavenging assays. The results indicated that fresh black plum fruits contain a significant high content of polyphenols (25.83 ± 2.66 mg gallic acid/g), while dried fruits had the lowest content of polyphenols (15.12 ± 0.97 mg gallic acid/g). The contents of flavonoids, anthocyanin, ascorbic acid and β -carotene are also high in fresh fruits (3.823 ± 0.155 mg rutin/g, 0.164 ± 0.007 mg of cyanidine-3-glucoside/g, 4.69 ± 0.58 mg/100g, 3.743 ± 0.054 mg/100g, respectively) and the lowest content is shown by fruit juice. Similarly total antioxidant capacity is high in fresh fruits (25.02 ± 1.50 mg of ascorbic acid equivalent/g) rather dried fruits (18.92 ± 0.25 mg of ascorbic acid equivalent/g) and juice (19.90 ± 6.16 mg of ascorbic acid equivalent/g). At the same time, results revealed that both drying and juice processing reduce the contents of bio-actives and antioxidant properties. With compared to commonly known fruits such as banana, pineapple, mango and starfruit, content of total phenolics (0.118 ± 0.004 , 0.479 ± 0.014 , 0.560 ± 0.046 , and 1.429 ± 0.071 mg gallic acid/g; Ramma *et al.*, 2003) is significantly high in black plum fruits even after processing. Black plum fruits are thus a significant source of natural antioxidants, which may have potential beneficial effects on health. However, these properties depend on the processing techniques applied for black plum fruits.

Keywords: Antioxidant activity, drying, juice preparation, *Syzygium cumini*

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Physiochemical, functional and antioxidant properties of rice bran protein concentrates isolated from At 308, At 362 and BG 300 Sri Lankan rice varieties.

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Rice bran is an underutilized byproduct of the rice milling process. Rice bran can be used as a value added product in the food industry. It is not used in Sri Lanka except for the production of bran oil, bakery foods and animal feed. In this research three of commonly consumed Sri Lankan rice varieties (At 308, At 362, and BG 300) were used for the extraction of rice bran protein. This study was carried out to extract rice bran protein from At 308, At 362, and BG 300 rice varieties, and to evaluate physiochemical, functional and antioxidant properties of rice bran protein concentrates (RBPCs).

Alkaline extraction and isoelectric precipitation were used to prepare rice bran protein concentrates from defatted rice bran. Physiochemical, functional and antioxidant properties of RBPCs were analyzed in comparison to casein and ascorbic acid. The protein content of RBPCs ranged between 38.2 and 54.9%. At 362 exhibited highest reducing power, total antioxidant assay and DPPH radical scavenging activity compared to other two rice varieties. The water binding capacity of RBPCs ranged between 0.73 and 2.26 (g/g), while oil absorption capacity ranged between 1.09 and 2.00 (g/g). At 308 had highest bulk density (0.89 g/ml). Emulsifying capacity of RBPCs was in the range 11%- 70%. Emulsions were stable under pH 7, sugar 1.5% and salt 1% conditions compared to other pH, sugar and salt conditions. Nitrogen solubility was highest for At 308 than that of BG300 and At 362 protein concentrates. Foaming capacity was highest for BG 300. The results of this research suggest that RBPCs have the potential of being incorporated into the food manufacturing process, in addition to bakery food production, considering its physiochemical, functional and antioxidant properties.

Key words: Protein extraction, rice bran, Sri Lanka

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Evaluation of flour prepared from Gahala (*Colocasia esculenta*), Innala (*Plectranthus rotundifolius*), and Kiriala (*Xanthosomasagittifolium*) in bread making

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Due to the cost, high demand, and geographical scarcity of wheat flour, there have been attempts to find a suitable replacement, especially in tropical areas including Sri Lanka. Sole replacement by foreign flours has not shown positive results. The use of composite flour has given comparatively better results. Gahala, Innala, and Kiriala, which grow in Sri Lanka, are potential flour and bread making sources. However, there have not been enough studies performed locally on this regard. Thus, the focus of this study is to check out the suitability of these yam flours for incorporation with wheat flour, in terms of bread making. The study consisted of flour preparation, a proximate analysis and analysis of rheological properties, preparation of bread, and evaluation of bread with the relevant yam flours sensory wise, and by bread scoring. Blend levels from yam flours used for composite flour were 10%, 20%, and 30%. As the controller 100% wheat flour was used. Flour preparation was done by drying the yams and grinding them. A.O.A.C. approved methods were used for determining the proximate composition. Rheological properties for the various blend levels were evaluated by Farinogram and Extensogram analysis. Bread was prepared according to the A.A.C.C.I 10-10.03 method and was evaluated for sensory properties and bread score. According to the results obtained, carbohydrate amounts were $82.36 \pm 2.82\%$, $81.94 \pm 2.59\%$, and $81.29 \pm 2.68\%$ for Gahala, Innala, and Kiriala flour respectively. Protein levels were $1.80 \pm 0.03\%$, $1.44 \pm 0.04\%$, and $1.27 \pm 0.03\%$; fat levels $1.92 \pm 0.07\%$, $2.04 \pm 0.01\%$, and $2.32 \pm 0.02\%$; moisture levels $10.42 \pm 0.16\%$, $11.02 \pm 0.18\%$, and $11.43 \pm 0.15\%$; ash levels were $1.75 \pm 0.09\%$, $2.03 \pm 0.06\%$, and $1.89 \pm 0.06\%$; crude fiber was $1.75 \pm 0.20\%$, $1.56 \pm 0.20\%$, and $1.79 \pm 0.17\%$, for Gahala, Innala, and Kiriala, respectively. Farinogram analysis revealed that 10% incorporation of Gahala flour results in 67% of water absorption, 6 minutes of dough development time, 2 minutes of arrival time and 23.5 minutes of stability. As for Innala the respective values were 60%, 7.5 minutes, 1 minute, and 20 minutes. Extensogram revealed 121.7 mm of Extensibility, 518 BU of resistance to extension, 617.7 BU of maximum ration, and 4.3 of ration number for 10% Gahala dough whereas the values were 112.7, 514.6, 620, and 4.6 for 10% Innala dough. The developed breads showed that with the incorporation of yam flour there was a decline in the rise of bread. Each bread type had characteristic odors of their yam. According to the sensory analysis the breads corresponding to 10% blend level were comparable in overall acceptability with normal wheat bread. Both 20% and 30% blend levels resulted in significantly different breads compared to the control. These sensory results are true for both Gahala flour and Innala flour incorporated breads. Thus, it was concluded that 10% was the most suitable blend level among selected composite flours, when considering the sensory evaluation & bread scoring, for bread making with Gahala and Innala flour incorporation. Further studies are suggested to obtain improved breads.

Keywords: Bread; composite flour; Gahala, Innala, Kiriala

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Isolation of arabinoxylan gum from leaves of *Neolitsea cassia* as a thickening agent for sauce

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Arabinoxylan is a complex non-starchy polysaccharide classified as a dietary fiber, which consists mainly of the cell wall of the cereals. In the food industry, commercially available arabinoxylan is used as a gelling agent, thickener, stabilizer and emulsifier. Other than the cereal some specific plants also contain arabinoxylan gum. Among the native plants in Sri Lanka, *Neolitsea cassia* is used for the preparation of a specific traditional sweet called "Asmi." But there is a limited amount of research done on this specific plant until now. The aim of this study was to isolate arabinoxylan gum from leaves of *Neolitsea cassia* and evaluate the suitability of the isolated gum as a thickening agent for sauce. Water extractable method was used to isolate the gum from leaves. Ethanol was used to precipitate polysaccharides from dried leaf powder and Fehling's solution was used in the purification process. The extractable arabinoxylan content was 1.02% on a dried basis. In order to determine the suitability of the gum as a thickening agent, its functional properties were studied. According to the results, the water holding capacity and the oil holding capacity were $288.82 \pm 0.67\%$ and $166.67 \pm 1.79\%$, respectively. Its solubility was $80.25 \pm 1.02\%$. A 5% (w/v) gum solution gave 395.00 ± 2.57 cp viscosity. Emulsion activity was determined using a 1%(w/v) gum solution. The latter part of the research was carried out to evaluate the suitability of the gum as a thickening agent for sauce. Different concentrations of the isolated gum (0.5%, 1%, 1.5% and 2%) was incorporated into tomato sauce, and functional properties were evaluated. According to the results, there was no significant difference ($p = 0.05$) between 2% arabinoxylan incorporated tomato sauce and commercially available tomato sauce. Finally, it can be concluded that arabinoxylan gum extracted from leaves of *Neolitsea cassia* can be incorporated to food models as a thickening agent.

Keywords: Arabinoxylan, arabinose, Emulsion stability, viscosity, physiochemical property, functional property.

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Proximate composition and mineral assay of flour obtained from Gahala (*Colocasia esculenta*), Kiriala (*Xanthosomasagittifolium*) and Innala (*Plectranthusrotundifolius*)

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Gahala(*Colocasia esculenta*), Kiriala(*Xanthosomasagittifolium*), and Innala (*Plectranthusrotundifolius*) are three underutilized yam varieties in Sri Lanka, which are having a good potential to be utilized for various aspects in food industry. Therefore, research was conducted to analyze proximate composition and selected minerals in flour obtained from these three yam species. Flour samples were prepared from *C. esculenta*, *X. sagittifolium* and *P. rotundifolius*, and the flour yield was determined. Proximate composition was determined using AOAC methods and mineral element composition (Calcium, Iron, Zinc, Cadmium, Lead) was determined using Atomic Absorption spectrophotometry.

The flour yield of three yam varieties was different. Kiriala had the best flour yield (20.7%) and Innala gave the lowest flour yield (11.39%). the flour yield of Gahala was 14.5%. The highest moisture content ($80.46 \pm 1.41\%$) was recorded for Gahala when compared with Kiriala ($69.77 \pm 1.09\%$) and Innala ($77.91 \pm 1.06\%$). The protein content of Innala ($9.63 \pm 0.95\%$) was significantly higher than that of Kiriala ($5.39 \pm 1.13\%$) and Gahala ($3.52 \pm 0.23\%$). The crude fat content of the three yam flours ranged between $0.006 \pm 0.003\%$ to $0.570 \pm 0.358\%$. Innala flour had the lowest fat content whereas Kiriala flour had the highest. A considerable amount of crude fiber was present in Kiriala flour (13.75 ± 9.73) while Gahala flour (11.25 ± 3.33) and Innala flour (11.35 ± 69.68) exhibited lower amounts. The ash content of yam flours ranged between $2.08 \pm 0.57\%$ to $3.67 \pm 0.01\%$. Calcium was the principal mineral in each type of yam flour. The highest Calcium content was recorded for Gahala flour ($0.23 \pm 0.01\%$). Nutritionally important Calcium rich flour can be utilized in food industry as a good source of Calcium. Iron ranged between $0.007 \pm 0.00\%$ to $0.009 \pm 0.00\%$ and Zinc ranged between $0.002 \pm 0.00\%$ to $0.009 \pm 0.00\%$ for the three yam flours. Cadmium and Lead were not detected in each of tuber flours, revealing that there are no potential toxicities of heavy metals. Hence these underutilized yam varieties can be effectively utilized in various processing activities of food industry and also to incorporate into other products.

Keywords: Flour, yams, Proximate composition



226/B

Evaluation of chitinase activity of Sri Lankan *Bacillus thuringiensis* strains

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Bacillus thuringiensis (*Bt*) is widely used as a bio-pesticide owing to the toxic proteins *Cry*, *Cyt* and *Vip* produced during their growth stages. Many strains of *Bt* produce *chitinase* enzyme, which can enhance the insecticidal activity by degrading the chitin in exoskeleton of insect pests as well as by degrading the chitin component in the peritrophic membrane of the insect midgut, which facilitates the entrance of toxic proteins to the midgut. The objective of the current study was to evaluate the chitinase activity of native *Bt* strains. Seventeen chitinase producing *Bt* strains of subspecies *Bt kurstaki* (AB8, AB15, AB20, AB49), *Bt graciosensis* (AB6, AB7, AB10, AB11, AB12, AB13, AB14 and AB16), *Bt poloniensis* (AB17), *Bt canadensis* (AB19), *Bt konkukian* (AB23), and *Bt israelensis* (AB22, AB24), selected from a qualitative disk dip assay, were used in this study. Fresh *Bt* cultures (1 mL) were inoculated separately into 10 mL of LB medium (containing 1% colloidal chitin) and incubated overnight at 37°C with shaking at 200 rpm. The cultures were transferred into 250 mL chitinase inducing broth (supplemented with 1% colloidal chitin) and incubated at 37°C on a rotary shaker at 200 rpm for 3 days. Proteins in the culture supernatant fluid were precipitated with ethyl alcohol at -20°C overnight. The precipitate was recovered by centrifugation and dissolved in 1.5 mL of 0.1M Na-phosphate buffer (pH 7.0). Chitinase activity was measured by the reduction of N-acetyl-D-glucosamine released by enzymatic hydrolysis of chitin using DNS assay. The absorbance was recorded at 535 nm. Readings were compared with a standard curve prepared with a series of dilutions of NAG (0–10 mg/mL). The chitinase activity was assayed in triplicate for each strain. One chitinase activity unit (U) was defined as the amount of enzyme required producing 1 μmol of NAG in 1 h. Standard *Bt aizawi* strain exhibited the highest chitinase activity of 3.345 U/mL. Of the 17 *Bt* strains screened, all strains exhibited chitinase activity ranging from 1.717 to 2.558 U/mL. Two *Bt kurstaki* strains (AB15 and AB20) exhibited higher chitinase activity of 2.558 U/mL, which is the highest recorded out of the tested strains. Further, these *Bt* strains contained a mixture of lepidopteran, coleopteran, and dipteran toxic genes as characterized by PCR analysis previously. This study demonstrated that these *Bt* strains could enhance the insecticidal activity of *Bt* due to the production of chitinase enzyme.

Keywords: *Bacillus thuringiensis*, Chitinolytic strains, DNS assay

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Low salted dry fish production and value addition to dry fish by incorporating herbal salt extracted from *Halosarcia indica* (willd.) Paul G.Wilson

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Halosarcia indica (willd.) Paul G.Wilson is an underutilized, freely available, medicinal herb widely distributed in coastal areas of different parts of the world. Even though this plant has been reported in many countries, information on phytochemical content and their sustainable utilization is lacking. On the other hand, the high salt content of dry fish has been identified as a one of the leading causes for cardiovascular disease. Therefore, in the present study attempts were made to investigate the possibilities of utilization of sodium and phytochemical rich extract of *Halosarcia indica*, for low salted dry fish production, as a value addition to the dry fish industry. Low salted dry fish production was carried out using *Oreochromis mossambicus* at four different salt concentrations (0%, 5%, 10%, and 15%) of normal and herbal salt. Fish was dried in an oven at 60-70 °C for 14 hours. A series of chemical parameters (salinity, pH, water activity (aW) and moisture content), physical parameters (Microbial analysis of Aerobic Plate Count (APC), yeast and mold count), and functional properties (total phenolic content, total flavonoid acid and antioxidant capacity) and sensory attributes of experimentally prepared dried fish were determined. The dried fish prepared with herbal salt with the concentrations of 10% and 15% showed the lowest microbial count, higher physical, chemical, biological properties and consumer preference. Therefore, herbal salt extracted from *Halosarcia indica* can be suggested to produce low salted dry fish, which provides several health benefits.

Keywords: *Halosarcia indica*, *Oreochromis mossambicus*, dried fish, Herbal salt.

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Section C

301/C

Assessment of the exposure of Sri Lanka to tsunamis generated at the Sunda Trench

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Sri Lanka is potentially exposed to tsunamis generated in two undersea subduction zones, Sunda and the Makran Fault. As both zones are located thousands of kilometres away, it is evident that Sri Lanka is exposed to far field tsunamis as opposed to near field tsunamis. The 2004 Indian Ocean Tsunami and the other tsunamis for which alerts were issued in Sri Lanka were generated in the Sunda Trench, and in this study, attention was focused on the assessment of the exposure of Sri Lanka to potential tsunami events generated in the Sunda Trench. Under such circumstances, an early warning system would play a vital role in mitigating the adverse impacts of tsunamis and such a system could be developed effectively by an assessment of the exposure of the country to potential tsunami events generated in the subduction zones. Computer simulation of tsunami propagation based on mathematical modeling techniques was used for this purpose and the tsunami wave height in the coastal waters was considered to assess the level of exposure. The mathematical model MOST (Method of Splitting Tsunamis) together with its interface ComMIT, developed by the National Oceanic and Atmospheric Administration (NOAA) was used for the computer simulations. Although it is capable of simulating deep water and shallow water propagation of tsunamis as well as overland inundation, in this study, the simulations were carried out only to assess the tsunami wave characteristics in the nearshore region, mainly due to the absence of required bathymetric and topographic information. The potential tsunami events generated by earthquakes of magnitudes (M_w) of 7.5, 8.0, 8.5, 8.8 and 9.1 in five selected segments of the Sunda Trench were considered in the simulations. The tsunami wave characteristics (maximum height) in the coastal waters were considered to assess the level of exposure. Locations in coastal waters in the vicinity of Trincomalee, Galle, and Colombo were considered to assess the tsunami wave characteristics. Altogether 78 simulations were carried out and the level of exposure was classified as 'High' for maximum wave heights greater than 2 m, 'Moderate' for heights between 0.5 m to 2 m and 'Low' for heights less than 0.5 m, based on previous studies and the experiences associated with the Indian Ocean Tsunami in 2004. A significant variation of the maximum tsunami wave height and associated levels of exposure, with respect to the earthquake magnitude as well as the segment (location) of generation is evident from the results. The western coastal areas (Colombo) are relatively sheltered, although 'High' levels of exposure are evident in the southern areas (Galle). Even on the eastern coastline (Trincomalee), a significant variation of the level of exposure is evident with the segment of generation of tsunamis. In view of these circumstances, the assessment of the exposure needs to be based on a larger number of simulations covering a wide range of locations and magnitudes of potential earthquake scenarios and associated tsunami events.

Key words: Tsunami, Exposure, Sri Lanka, Sunda Trench

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302/C

Tsunami Housing Villages: A post occupancy evaluation

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The world's fifth-largest quake in a century hit Southern Asia on 26th December 2004, unleashing tsunamis that swept across the Indian Ocean, spawned by a magnitude 9.0 earthquake off the coast of Sumatra. Aside from Indonesia, Sri Lanka likely suffered the most casualties. It has been over 10 years since this ravaging tsunami hit the southeast Asian region. A number of housing solutions have been provided for the victims affected by the tsunami during these 10 years. The purpose of the study is to document perspectives of the residents of these houses through post occupancy evaluations. Periodic evaluations of user expectations and user satisfaction are the basis for post occupancy evaluations and provide insight into how improvements can be made in such future development projects.

A village that was established to house people who were displaced due to the tsunami was selected as a preliminary location to conduct an initial survey on post occupancy evaluation of these residences. Thirty households in the village located on the southern coast of Sri Lanka were initially randomly recruited, and the survey was answered by the head of the household. The questionnaire contained questions under four main sections: User perception of the dwelling, User perception of the immediate neighborhood, Future expectations, and Demographic information.

Findings suggest that the overall satisfaction level with the housing and its surrounding has not changed significantly with time. One space that the residents had issues with was the kitchen. The majority of the houses (58.6%) have been modified by the inhabitants to suit their needs. Currently the majority of the inhabitants (70%) think of these houses as a permanent housing solution.

This study will provide a background and a base for a large scale national level study on similar developments. While this study provides user perception about the current situation in this tsunami village, the study will also provide insight into how improvements can be made in future developments of similar nature especially in terms of disaster mitigation efforts.

Key words: Post Occupancy Evaluation, Architecture, Disaster Management

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303/C

Assessment of the extent of salt water intrusion and vulnerability of freshwater aquifers at Koggala lagoon area

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Groundwater is very important and is the only source of fresh water in the coastal belt of Sri Lanka, especially in the sand stretches located between brackish water lagoons and the sea. Therefore this study was conducted to assess the extent of the saltwater intrusion in the Koggala lagoon area, Galle District, Southern Province in Sri Lanka. The objectives of the research were to investigate salt affected area at Koggala lagoon and assess the vulnerability of fresh water aquifers at Koggala area to salt water intrusion.

Electrical conductivity values (at three different depths, viz., surface, middle and bottom) of 57 selected dug wells located within 700m from the Lagoon bank were measured during the study period from March 2017 to August 2017. Further, undisturbed soil samples collected at the lagoon bank were analyzed for hydraulic conductivity and for particle size analysis.

It was noted that salinity levels and electrical conductivity fluctuate considerably with high rainfall. During the study average EC levels of dug wells drastically decreased in June due to comparatively high rainfall and dilution. Electrical conductivity values of many wells in the seaside were above the desirable level of 750 $\mu\text{S}/\text{cm}$, stipulated in Sri Lankan drinking water quality standards of SLS 614(1983), while other wells in the seaside have exceeded the permissible level of 3500 $\mu\text{S}/\text{cm}$ in the dry months, March and April. However, all the dug wells located on the inland side have not exceeded the maximum permissible level of EC during the study period.

This study reveals that there is significant correlation between EC values of the dug wells and distance from the lagoon bank while the wells located beside the lagoon mouth, in between sea and the lagoon have comparatively higher EC values due to salt water intrusion.

Key Words: Salt water intrusion, Fresh water acquirers, Vulnerability, Koggala lagoon area, Electrical conductivity.

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304/C

Septic tank with up flow anaerobic filter compact unit for treating domestic wastewater in low-lying areas

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Improper disposal of domestic wastewater to free water bodies and ground, leading to contamination of water bodies and ground water, has become a significant issue. Especially in high water table areas, wastewater is in direct contact with ground water. When constructing a proper disposal system, it is required to have well engineered design that matches with available space. Therefore, construction of site specific septic tank and anaerobic filter is not common due to lack of expertise, and therefore installation of readymade septic tank units, which are easy to install, is popular. This research is aimed to design and develop a compact treatment unit consisting of a septic tank and up-flow anaerobic filter, using construction aggregate and bio char as filter media for treating domestic wastewater, and to estimate its performance.

The septic tank treatment systems, circular and rectangular, were designed according to SLS 745 guidelines and fabricated using grade 20 concrete. Circular units were designed to be lighter in weight and to have sufficient strength. Rectangular and circular units with 0% of bio char with metal packing were considered as control units. To achieve flexural stability of tank walls and base, they were constructed with 75mm thick walls and 100mm thick base. The bio char, 10%, 20% and 50%, was added to the metal media with 25mm-50mm range, and the hydraulic design was prepared considering the daily discharge of 5 person per dwelling. The retention time was considered as 14.5hrs. The internal diameter of the treatment unit was 1200mm, while the total length was 1900mm. The discharge water was tested for pH, TN, phosphate, BOD5 and COD following APHA wastewater examination methods.

With the introduction of bio char, the percentage removal rate of Nitrate and BOD5 increases. The designed units with metal filter media showed considerable removal of COD, BOD5, and TN, at around 73mg/l, 43mg/l and 45mg/l, respectively. After introduction of bio char, all parameters met stipulated guidelines. The designed compact units gave good performance for removal of organic matter satisfactorily. The space requirement for circular section was 5ftx12ft. It is required to desludge the septic tank component annually to get better performance and interruption free function. The system with circular section has shown easy installation and promising results, and therefore is recommended for use specifically in areas with high water tables to protect ground water from contamination.

Key Words: Up flow anaerobic filter, Septic tank, compact unit, domestic wastewater

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305/C

Energy efficiency and sustainability of wastewater treatment plants

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Energy efficiency and sustainability of three wastewater (ww) treatment plants operating on Anaerobic-anoxic-oxic (A₂O) and oxidation ditch systems (Plant A- A₂O System, Plant B –A₂O system and Plant C- Oxidation Ditch System) were studied to investigate the energy efficiency and overall effectiveness (economical, environmental and social) of ww treatment. Energy consumption was obtained from an onsite survey and level one energy audit. Key performance indicators (KPI₁₋₄ based on energy consumption) and load factor (operational index) were used to evaluate the energy efficiencies of treatment technologies. Further, sustainable indicators (capital cost, operational cost, community size served, level of nuisance from odor BOD₅ removal efficiency, N-removal efficiency, P-removal efficiency) were used to identify the economic and social sustainability of the plants while life cycle assessment results were incorporated to evaluate the environmental sustainability of each ww treatment plant. According to the KPI's (KPI₁₋₃) calculated, plant A needed a higher amount of energy to treat 1m³ of ww, one PE, and to remove one kg of COD, than plant C (95% confidence level). But Plant A showed the highest BOD₅ and N removal efficiency from all the three plants (95% confidence level). Although plant C showed lower values for KPI₁₋₃, their removal efficiencies were lower compared to plant A. Further, KPI₃ and KPI₄ showed a higher values for plant A than for plant B. From the two wastewater treatment technologies considered, the oxidation ditch process gave the highest impact in six out of seven life cycle impacts categories considered. When the overall impacts from LCA were considered, Plant B showed the lowest environmental impacts in all seven impact categories while plant C showed the highest impact in a majority of the categories. Hence when the overall sustainability is considered (economic, social and environmental sustainability) A₂O process is identified as the more sustainable and energy efficient wastewater treatment technology to treat wastewater.

Keywords- Impact categories, Key performance indicators, Life cycle assessment, treatment technology

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306/C

Sustainability of coastal windows: Case study on the Colombo coastal region, Sri Lanka

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The coastal zone is the interface between the land and the sea, which has complex systems affected both by terrestrial and marine processes. Human presence influences the systems, adding more pressure and threatening the sustainability. Hence sustainability requires managing activities at individual, community and national levels, ensuring that the economy and society can continue to exist without destroying the natural environment. The coastal belt around Colombo is full of properties and features, which have long been exploited and which contribute towards the wealth and the quality of life of the people. The past and ongoing developments in the Colombo business district and the developments in the Colombo coastal window have led to conflicts. This massive development has a significant impact on the natural resources of the coastal zone. Taking a closer look at recent ongoing development projects and how those projects will affect social, economic and environmental sustainability is important. This research is aimed at determining the main forces influencing development of coastal areas, and assessing the present use and manage future exploitation of the coastal zone following the sustainability concepts.

The study area lies 10 km on both sides to north and south of the Colombo port. Presuming that some of the natural systems of the western coast line are exclusively interlinked, the system was investigated in finite coastal segments that are derived in accordance with the coastal characteristics. A monitoring system with scientific evidences for maintaining the functional integrity of the natural coastal system was developed for investigations, and analytical software platforms computer models were used to model the system.

As examined, changes to the coastline of Colombo and outskirts are being made with the new expansion of commercial harbour, port city, and Dikowita fisheries harbour. Being the shorefront in the Colombo city, this coastal region is economically highly sensitive. This study provided the principal scientific evidence on shoreline stability, health and sensitivity of eco systems, process for informed coastal administration, and maintaining the functional integrity of the natural coast. Excessive policies on sustainability could cause much more different results to the western coastal region than expected, and therefore discussion towards a balance in environment and economy through integration of policies that connect to the natural system are highly important.

Key words: Colombo coastal window, Port City, functional integrity, shoreline stability, coastal process.

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Assessment of the Exposure of Sri Lanka to Tsunamis generated at the Makran Fault

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Although tsunamis have not been frequent in Sri Lanka in the past, in view of the tsunami in 2004 and the subsequent tsunami alerts issued, it is evident that tsunamis can be considered as a natural hazard to which the country is exposed. Tsunamis are mainly generated by undersea earthquakes in subduction zones and Sri Lanka is exposed to two such zones, the Sunda trench and the Makran Fault. The tsunami in 2004 and other tsunami alerts issued in the country are associated with the Sunda Tranch and many of the studies on tsunami hazards in Sri Lanka have focused the attention on such hazards originating in the Sunda trench and relatively less attention has paid for the study of tsunami hazards originating in the Makran Fault. In this study, attention was focused on the assessment of the exposure of Sri Lanka to tsunami hazards from the Makran Fault. The Makran Fault or the Makran Subduction Zone (MSZ) is located to the northeast of Sri Lanka. Although tsunamis generated in the MSZ have not affected Sri Lanka in the recent past, records of historical earthquake and tsunami events in the MSZ indicate that the exposure of Sri Lanka to such potential events in the future cannot be ruled out. The study was based on mathematical modeling techniques and the mathematical model MOST (Method of Splitting Tsunamis) together with its interface ComMIT, developed by the National Oceanic and Atmospheric Administration (NOAA) was used for the computer simulation of tsunamis. The maximum tsunami wave height at selected locations was used to assess the level of exposure. Although the model is capable of simulating deep water and shallow water propagation of tsunamis as well as overland inundation, in this study, the simulations were carried out to only to assess the tsunami wave characteristics in the nearshore region, mainly due to the absence of required bathymetric and topographic information to simulate inundation characteristics. A number of simulations, representing a range of potential tsunami events were carried out. The representative propagation maps obtained by modeling indicate that the propagation is mainly southwards with no significant spread towards the coastal waters of Sri Lanka. In this initial study, a number of tsunami simulations were carried out but the maximum earthquake magnitude considered was limited to 8.8 due to modeling restrictions. No large tsunami wave heights were evident in the scenarios considered with the maximum wave height of 40 cm at a depth of 4.5 m in the vicinity of Colombo. The tsunami arrival times were in excess of 4 hours, which indicate adequate times for early warning of hazards. Although no significant levels of exposure are evident in the results obtained by this initial study, it would be more appropriate to conduct extensive tsunami simulation studies covering a wider range of scenarios for a more effective level of assessment of exposure of Sri Lanka to tsunamis generated at the Makran Fault.

Key words: Tsunami, Exposure, Sri Lanka, Makran Fault

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308/C

Investigation of Flat Slabs in Sri Lanka

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Extremely high demand for upstairs buildings in the world leads to strong demand for Flat Slabs. The traditional practice is to construct the slab on the beams and support the beams on the columns, which known as "Conventional Slab Beam." The main adverse effect of conventional slab beam is losing the clear height. Changing the traditional concept by resting slab directly on the columns, without the support of the visible beams is known as the concept of "Flat Slabs."

The main objective of this study is to identify the prominent influencing factors such as durability, efficiency, workability, appearance, attitude of designers, strength, and stability, which affects the usage of flat slabs, compared to the Conventional Slab Beam. Also this study provides a comparison between flat slabs and conventional slabs regarding the design aspects, cost involved and self-weight.

The questionnaire survey was carried out among designers, contractors, and consultants of 50 high rise building with 2 floors and above. Descriptive and inferential statistical methods were used for analysing the data of the questionnaire, and structural software, namely AUTO CAD, Etabs, and SAP2000, were used to analyse the structural design, and the cost per unit area.

The results revealed that the strongest factors in favour of selecting flat slabs are workability and the attitude of designers and contractors. Cost analysis showed that there is 26% of additional cost per 1 m² of flat slab, when compared to the conventional slabs. Analysis of structures showed around a 25% increase in the self-weight of flat slabs. In addition, the low stiffness of flat slabs tends to cause them to fail when applying lateral loads. According to this study it has been proven that flat slabs have poor safety aspects when compared to the conventional slab beam. However, the application of flat slabs with shear walls will give good structural stability and hence the research in this area is needed.

Key Words: Flat, Higher Self Weight, Durability, Shear Walls.

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309/C

Light weight cement stabilised bricks with partial replacement of rice husk ash

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Utilization of rice husk ash (RHA) for producing cement stabilized earth bricks has been studied as a partial replacement for ordinary Portland cement (OPC). The Rice Husk Ash (RHA) was collected from a rice mill from Akuregoda area, Battaramulla and the soil used was from Artigala area, Kaduwela in the Western province. Hundred and fifty bricks with different mix proportions of RHA, cement and soil were cast and tested according to the SLS 1382 Part 1, 2, and 3 standards. The overall mix ratio of 1:7 (one part of binder to seven parts of soil) was used and OPC was replaced with RHA at different replacement levels of 0%, 20%, 30%, 50%, and 60%. 305 mm×155 mm×100 mm sized bricks were cast, cured and crushed for 7, 14, 28 and 35 days. Engineering properties such as compressive strength, water absorption, linear expansion, size and shape were studied. The engineering properties of bricks with different mixed proportions were compared with normal stabilized bricks to determine the optimum replacement levels of RHA for earth bricks. Twenty eight day compressive strength decreased from 4.01 ± 0.02 to 1.9 ± 0.04 N/mm² when the RHA content increased from 0 to 60%, respectively. Blocks made out of 0%, 20% and 30% RHA was measured to have a compressive strength of 4.01 ± 0.04 , 3.88 ± 0.07 and 3.08 ± 0.09 N/mm², respectively. They were within the required standard of compressive strength ($2.6-6$ N/mm²) as mentioned in CSEB standard, SLS 1382 part 1. Other percentages of replacement levels did not meet the standard compressive strength levels. When water absorption of the blocks were considered, 20-30% of OPC could be seen as the optimum RHA replacement, yielding the SLS standards. The average values of linear expansion of all mix proportions were within the specified upper limits ($< 0.10\%$) implying no significant effect on linear expansion of blocks with the addition of RHA content. Considering all the important parameters, it could be concluded that OPC can be easily replaced by 30%, yielding the cheapest block complying with the SLS standard. It also helped to reduce the weight of the blocks by 10% and reduce the cost by 30%.

Keywords: Compressive strength, Linear expansion, optimum replacement, water absorption.

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310/C

Review on quantifying the carbon footprint in a construction project in the supply chain management

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Global warming has been identified as a major threat for the existing climate. The construction industry emits a significant amount of Greenhouse gas (GHG) to the atmosphere which quantifies as the “carbon footprint” (CF) consisting of mainly CO₂ emission. The Supply chain management plays a vital role in the construction projects, which are involved in transportation and energy/fuel use, affecting GHG emission. The main objectives of this paper are to understand the existing methods in quantifying the carbon footprint, and their application in supply chain management in the construction industry. A systematic literature search was done with the key terms of carbon footprint, construction industry GHG emission and supply chain management. Three different methods in calculating CF in different sectors were analyzed to quantify the CF in the supply chain management in the construction industry.

The CO₂ emitting activities can be identified using Project Management Techniques, introducing Macro and Micro level indicators and operational and embodied emissions in the Total Life Cycle (TLC) CO₂ emission of the project. The DEFRA greenhouse gas conversion factors and the EIO-LCA model are used to calculate supply chain emissions of the above identified activities within the life cycle stages of the construction. During the literature survey, it was identified that there are lapses in quantifying the greenhouse gas emission in the human activities. Both activity data and DEFRA greenhouse gas conversion factors, can be used to calculate the total carbon dioxide content. The EIO-LCA model can also be used with the collected data.

To identify the activities in the industry, one of the above methods can be used. It is essential to prepare a list of data for Sri Lanka since the readily available data are only for Australia, USA and UK. Awareness programmes will help to reduce the energy and fuel consumption throughout the project lifecycle, which also can be used to prepare a database in calculating and minimizing the greenhouse effect.

Key words: Construction, Supply Chain, Carbon footprint.

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311/C

Assessment on expressway development to the ambient air quality

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As urbanization proceeds, new highways are constructed for transportation and development, and stream ecosystems within highway corridors are susceptible to impact from construction activities. The air pollutants which are released through the vehicular and construction sources alter the quality of the surrounding atmosphere, and some pollutants will cause acute as well as chronic respiratory impacts on human health. Pollutants including heavy metals such as Lead (Pb) and Zinc (Zn) with atmospheric particulate matter will deposit on ground surfaces via wet and dry deposition processes. The Outer Circular Highway Package III (OCH-NS II) is to be constructed as a four-lane dual carriageway facility with provision for eventual expansion to six lanes. OCH-NS II is the final segment of the three segments of the Outer Circular Highway, which links the Southern Expressway to the Colombo-Katunayake Expressway, commencing at the Kottawa Interchange, which is the northern end of the Southern Expressway (STDP) and terminating at Kerawalapitiya Interchange. This study was based on the monitoring of ambient air quality at selected locations throughout the Expressway trace during the construction phase. The air quality sampling was carried out on a monthly basis, *i.e.*, once the month from four selected sampling points, and the samples tested for ambient air quality parameters. Baseline survey for Ambient Air Quality was conducted before commencement of construction work, and the regular monitoring of initial air quality parameters were carried out while construction work were ongoing. All the collected Air Quality samples were tested for three air quality parameters namely NO₂, SO₂, and PM₁₀, according to the standard air quality testing procedures given in CEA standards.

The results revealed that NO₂, SO₂, and PM₁₀ are significantly higher than the baseline concentrations; however, they do not exceed the CEA stipulated values. The highest recorded NO₂ concentration was 120 µg/m³, slightly lower than the given CEA standard, *i.e.*, 140 µg/m³. As in the NO₂ concentration the highest recorded SO₂ concentration was 90 µg/m³, lower than the given CEA standard, *i.e.*, 120 µg/m³. Similarly, PM₁₀ concentrations were around 70 µg/m³, while the upper limit given by CEA is 100 µg/m³. However, the particulate Pb concentrations were not different from the baseline values. The percentage of the NO₂ increment compared to the baseline data is 40% and for SO₂ it is 45%, while for PM₁₀ it is 35% respectively. This study recommends that construction activities with heavy machinery has made significant changes in atmospheric air quality, and therefore precautions must be suggested through the EIA study.

Keywords: ambient air quality, urban development, outer circular highway, PM₁₀, NO₂

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Predicting Indoor Air Quality and Thermal Comfort using Energy Simulation and Computational Fluid Dynamics

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Buildings are designed in order to provide a healthy and a comfortable indoor environment for the occupants. Indoor air quality and thermal comfort are considered as the principal criteria for assessing the performance of buildings. Poor indoor air quality can lead to “Sick building syndrome” and other health related issues. Undesirable thermal comfort levels can affect the productivity of occupants in a drastic manner, especially in office buildings. Such issues can be addressed successfully at the early design stage of buildings using modelling and simulation methodologies. On this basis, the paper predicts the Carbon Dioxide (CO₂) levels and thermal comfort of occupants in an office building to be constructed at Ratmalana, Sri Lanka using Energy Simulation and Computational Fluid Dynamics (CFD). Three-dimensional computational model of the building consists of 1,692,867 hybrid mesh volumes. EnergyPlus v. 8.0 is used as the Energy Simulation tool and it predicts internal building envelope temperatures to be applied as boundary conditions for the CFD simulations. ANSYS Fluent 15.0 is used as the CFD tool for the analysis. The k-ε RNG model predicts turbulence with enhanced wall treatment approach. Diffusion of emissions is predicted by the species transport model in Fluent. Simulations predict the CO₂ concentration on occupant planes of the building. Furthermore, thermal comfort values at ankle level, waist level and neck level of occupants have also been predicted. The simulation results provide the building designers with a basic understanding of CO₂ and thermal comfort levels to be expected in the indoor environment at the intended location of the building, enabling them to take vital design decisions to enhance the performance of the same.

Keywords: Indoor Air Quality, Thermal Comfort, Energy Simulation, Computational Fluid Dynamics

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313/C

Automated Garbage Separation System

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With rapid urbanization and uncontrolled growth rate of population, municipal solid waste management has become an acute problem in Sri Lanka. The disaster at Meethotamulla points out the importance of proper waste management. Waste disposed of in landfills is not only impossible to reclaim because of the hazardous manner of dumping, but also has serious environmental implications in terms of ground water pollution and contributes to global warming. This reduces the average life span of the manual segregators. Development of a waste separator system will facilitate the recycling process. Hence it helps to gain a cleaner and a greener place, which is the purpose of this project.

This study focuses on the development of a mechanism to separate organic and inorganic waste, which is found in bulk. The proposed system consists of a magnetized funnel, air separator duct, rotatable barrel, linear actuator with capacitive proximity sensor, and vacuum pump. Metal parts are collected via a temporary magnet and lighter objects are separated from the air separator. The rest of the garbage is put down to the barrel. This barrel consists of an inner and outer barrel. The inner barrel has holes and an ultrasonic sensor. The ultrasonic sensor gives a signal to the linear actuator. When the barrel starts to rotate leftover lunch packets unfold and food waste goes through the holes in the inner barrel. The food waste is collected from the gate on the outer barrel. Remaining in the inner barrel are polythene and paper. The linear actuator with capacitive proximity sensor and vacuum pump is used to separate polythene and paper into organic and inorganic waste. After the barrel unfolds the leftover lunch packets, the linear actuator goes forward, identifies the object, and sucks it with the help of a vacuum pump. After that linear actuator goes backward and drops it into a suitable bin. Once the operation is completed, the permanent magnet switches off and the funnel door opens and collects the metal parts automatically.

The proposed system was capable of separating metal, polythene, plastic and food waste automatically. Therefore, the proposed system reduces the problems related to garbage separation, supports in waste management and reduces the environment pollution.

Keywords: Organic waste, inorganic waste, capacitive proximity sensors

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Preliminary study on automatic detection of Malitha flower

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Traditional practices of medicine use a lot of herbs for ailments in Sri Lanka. Hence, promoting these medicines is a pathway to heal many diseases causing fewer side effects. Malitha is one of the herbs used to prepare Ayurvedic medicine in India and Sri Lanka. The dried Malitha flowers are used for fermenting of medicinal wine. The quality of the imported raw material is not known since these ingredients are usually imported from India. The new trend of developing the end product will limit the exportation of raw material in future. Hence it is advisable to cultivate these types of herbs in Sri Lanka.

Malitha is a small flower. The size of the flower is 9-15mm. Thus identification of maturity of the Malitha flower and shortage of labour are the main constraints. Hence, the main aim of this study is to suggest a mechanism to identify the matured flower for the picking process. "Object detection" is the ability to distinguish an object from the background. Sensor based detection and image processing are two methods adapted for object detection. Recently image processing techniques have been proven to be an important tool for analysis in different fields and applications. Image processing in agriculture has been applied in the areas of sorting, grading, detection, and counting the products. Sensor based detection is more complicated, because of the ambient light and foliage. The ambient light can change throughout the day, therefore one needs to shield the sensors from this light. However, image processing has several techniques to reduce abrupt light effects in environment. Image segmentation is the first step in flower detection. There are several techniques and algorithms to perform the segmentation in the digital images. The region based segmentation method segments the image on the basis of low-level features of image color, texture and intensity. JSEG (J value based segmentation) has been shown to be more accurate in identifying nature properties. Therefore, it is convenient for detection of matured Malitha flower using JSEG technique. Finally, integrating this result with picking system will assist to pluck the matured Malitha flower.

Keywords: Image processing, JSEG technique, Malitha flower, Nature properties

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315/C

Design of an ultra-user friendly domestic water pump controller

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Water is one of the most important natural resources, which needs to be very carefully utilized in day to day life. In the domestic use of water, an overhead tank is filled using an electric water pump and the water is allowed to flow under gravity to the tap openings. In order to reduce both the wastage of water and the manpower, many automatic water pump control systems have been employed. In most of these systems, electrodes or vacuum balls placed inside the overhead tank measure the water level reading and it is conveyed to the controller which then activates an automatic on/off switch for the pump. However, among many drawbacks of these existing systems, the clogging of the sensors with the minerals in water and the resulting frequent maintenance requirements are prominent. At the same time, the installation of the system needs the knowledge of an expert. Further attempts to reduce the maintenance and to make the installation simple have been proposed by the use of ultrasonic distance measuring sensors and radio frequency (RF) based communication between the sensor at the overhead tank and the controller on the ground. But it does not provide an easy installation and maintenance mechanism. By considering these limitations, the ultra-user friendly water pump controller system was proposed, which does not require a sensor at the overhead tank; instead a sensor unit which can be fixed to a ground level tap opening measures the water pressure head to calculate the water level in the tank and send pressure head readings to the control unit via a wireless communication link. Further to the novel sensor node design, this pump controller consists of an easy to install modular design so that neither the technical expertise nor reaching the overhead tank is necessary. A prototype implemented demonstrates a slightly inferior accuracy in estimating the water level when compared to the existing systems. However, the obtained accuracy is sufficient in its practical domestic water pump control operation. Pressure readings are with low resolution and can be disturbed by the noise in readings, thus to increase the resolution, an averaging scheme is proposed, which averages the calculated water level estimates over six consecutive readings such that noise immunity is obtained. A prototype system employing this averaging demonstrated 100% pump on/off accuracy.

Keywords: Water, Overhead tank, Pressure reading, Pump control system

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316/C

Identification of Key Factors to Uplift Traditional Lac (*Laksha*) Craft in Sri Lanka

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Art and craft are key factors that can express the culture and traditions of a country. *Laksha* is a traditional craft in Sri Lanka, and it has an immense and enduring history. Lac is one of the decorative media that can be applied on different types of materials, such as wood, ivory, pottery, clothes, horns, and shells. But in current society it does not cater to present social needs. This can be considered as a dying industry, and as a traditional craft that was continued from generation to generation, even though it is not continued as before; it will become a dilapidated craft in the craft milieu after three or four generations. It is needed for future generations to identify their traditional techniques, tools, equipment, decorations, manufacturing methods and market opportunities. It is a cast based industry and was continued in several rural areas in Sri Lanka, and still continues in a few areas in country. Craftsmen in the Kandy and Matale districts, in particular, still continue their practices in the traditional manner. This research gathered factual data in the craft places in the Central Province. The methodology of the research was based on the Grounded theory method and a questionnaire survey aimed at selected craft villagers. The required data were collected through an extensive literature survey, and case studies on the use of a variety of Lac crafts. According to the research findings, the six key factors identified, in order of the importance, are introducing new technology, designs, materials, color experiments, conducting trainee programmes, and teaching as a technical subject. These are the main factors that should be considered to uplift the dying tradition of Sri Lankan lac craft.

Key words: Design, Tradition, Art & Craft, experiments, Lac work

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317/C

Finite element analysis of an excavator bucket to satisfy the industrial requirement

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An excavator is a machine used for construction activities. This consists of several components such as house, undercarriage, boom, stick and bucket. Excavators are found in many different sizes depending on the job that is required. Also the various types of buckets are used for different types of work. The aim of this research was to design and simulate an adjustable excavator bucket for mini wheel excavators. Design was done according to the specific industrial requirement, and the parameters of the bucket, such as bucket capacity and dimensions of the bucket, were theoretically calculated and some parameters were chosen from the manual guide of the selected brand. AISI4130 Alloy Steel was used for the design. The bucket was modelled and analyzed using SolidWorks modelling software.

SolidWorks static analysis was used for the simulation, and boundary conditions are selected after hand calculations for the bucket. Different mechanisms were used for the adjusting and optimizing, and most suitable mechanisms selected. Different boundary conditions such as load, fixtures, and pressure are the common such conditions of this simulation. The forces are defined such as digging force applied direction, and hinge plate holes used as the fixed points. The maximum digging force engaged from the main cylinder the same as arm and bucket cylinders, into the cutting edge of the bucket. These forces are defined by the selected excavator user manual. The displacement and stress strain failure were analysed, considering the practical application of the excavator bucket. After interpreting FEA results, stress displacement and strain are found to be within allowable stress limit. Moreover, design modification are made for reduced displacement by attaching the wear plates.

This paper discusses the stress, strain and displacement analysis of the design under various boundary conditions. The static conditions were modelled using SolidWorks software package and 346171 3D tetrahedral solid elements and 556850 nodes were used for the simulation. The Project was limited for the mini wheel excavator clean-up buckets and the BOB CAT brand, model E55W mini wheel excavator was selected for the analysis.

Key words: SolidWorks, FEA-Finite Element Analysis

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318/C

Design of a self-balancing rotatable mobile hoist for small workshop

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A hoist is a sort of machine, for the most part furnished with a crane rope, wire ropes, or chains, and piles, that can be utilized both to lift and lower materials and to move them on a level plane. It is chiefly utilized for lifting substantial things and transporting them to different places. It utilizes at least one straightforward machine to make mechanical advantage and hence move loads beyond the ordinary capability of a human. Hoists are usually utilized in the transport and construction industries. A mobile hoist, which is used for lifting heavy materials or products, such as machined metal blocks and engines, plays a major role in mechanical workshops. Once the object is lifted, the mobile hoist has rollers, which is useful for the operator to carry the lifted weight from one location to another location without any excessive strain to the human body.

Even though the mobile hoist plays a major role in the industry, it is unable to rotate the desired angle without moving the wheels. If the product is to be rotated, the hoist itself has had to be rotated. And after lifting a heavy object the hoist has to be rotated very easily. Especially in small workshops, this issue is a major problem because of the limited space. The jib crane and overhead crane give the convenience of lifting objects in narrow spaces, but they are more expensive and have to be built on heavy structural bases for support.

This paper discusses the design of a low cost self-balancing mobile hoist with rotation facility to overcome the above issues in small mechanical workshops. The design was done according to the specific requirement in small workshops and the maximum weight and height of lifting were limited to 1000kg and 1.7m, respectively. Dynamic analysis of the system was performed by using MATLAB software and the results were validated by experimental results.

Key words: Mobile hoist, MATLAB, Dynamic analysis

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319/C

Minimizing fuel consumption in printing process of glass bottle Industry

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The main problem in the glass industry is the high fuel consumption for the processes of annealing and printing. Therefore, this study was focused on finding the methods of minimizing fuel consumption in printing process.

After printing the bottles, they are sent through a lehr called the 'Decorating Lehr' to adhere the print to the glass permanently. This lehr consists of a number of zones having different temperatures. Heating of the zones are done by LP gas burners, which consume a large amount of LP gas. In this study two methods were identified as the best ways of minimizing fuel consumption.

The first method is to design a waste heat recovery system to increase the bottle entry temperature of the decorating lehr. It was found that using a plate fin type air to gas heat exchanger, the outlet temperature of the air can be increased to 210^oC using the excess heat of the decorating Lehr exhaust gas, and it can be used to heat the bottles when entering the decorating lehr. Thereby fuel consumption to heat the bottles at entry can be reduced. Reduction in fuel consumption will be quantified after completing the design of the heat exchanger.

The second method is to analyze the temperature profile of the decorating lehr. It was found that the cooling rate of the lehr can be changed by adjusting the mat speed of the conveyer belt. Calculations were carried out for different types of bottles and trial runs were carried out accordingly. By controlling the heaters in each zone, temperature profile of the lehr was adjusted based on theoretical calculations. Thereby, 30 – 38% fuel savings can be obtained. Using above two methods, it was shown that the fuel consumption of the decorating lehr can be minimized by a considerable amount.

Key words: Annealing lehr, Decorating lehr, fuel consumption, heat recovery, flue gas.

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320/C

Performance enhancement of a laboratory steam power plant condenser

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The steam power plant located at the Thermo-fluid laboratory of the Mechanical Engineering Department of the Open university Sri Lanka, gives an opportunity for undergraduate students as well as those engaged in research work to conduct tests and observe the workings of a steam power plant. The plant, which operates on a simple Rankin cycle, mainly consists of an electrical boiler, steam engine, condenser and other auxiliary components. It has been observed that continuous bleeding of steam occurs with the condensate into the condenser tank and the plant does not operate as intended. Initial tests conducted on the plant revealed that the condenser performance was not in compliance with the manufacturer's recommended values. A high degree of deviation was observed in the cooling water flow-rate and the delta temperature of the cooling water in-out from the condenser which could not be rectified with the present laboratory conditions. Therefore, this study was carried out with the aim of enhancing the performance of the condenser, especially to reduce the specific steam consumption (SSC) and to increase the overall efficiency of the plant, taking into consideration the limitations of the laboratory environment. Experimental analysis showed that an 18.5 kW heat rejection is to be maintained at the condenser if the plant is to comply with the manufacturer standards. Therefore, three different water circulation designs, Inclined plate, sprinkling water pouring system and cross flow evaporative heat exchanger were selected and evaluated. An optimum design was selected based on sprinkler water pouring system, which utilizes a cooling tower principle to reject heat from the cooling loop. The design, fabricated out of plastic and aluminum, consists of a vessel with 1.14 meter active cooling height which directly contacts water and air in counter flow arrangement aided by an axial flow exhaust fan. Four layers of square mesh were introduced in order to increase contact area of air and water and a centrifugal pump to maintain the required flow rate. Tests carried out after implementing the design shows an increase in overall plant efficiency by 135% and a reduction in the SSC to the desired manufacturer standards.

Key Words: Steam power plant, Condenser performance, Cooling tower, Overall plant efficiency.

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321/C

A techno-economic comparison of utilizing aerial bundled conductors with bare conductors in distribution systems

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Reliability of distribution systems becomes more important since consumers expect uninterrupted supply irrespective of external circumstances. Frequently, bare conductors are used in many of the distribution systems. From the economical point of view, the utilization of bare conductors in distribution lines is more appropriate. Reliability of distribution lines with bare conductors is low due to both environmental effects and human activities. Therefore utility companies may incur revenue losses due to unserved energy to the consumers. The reliability of distribution systems with aerial bundled conductors is high but they are expensive. In this work, the cost of utilizing aerial bundled conductors has been compared with the bare conductors considering the cost of unserved energy. Reliability parameters of feeders with bare conductors of a distribution system in the coastal area of the country have been calculated. For a particular year, the unserved energy due to bare conductor failures was calculated in the selected area. The cost of the unserved energy was calculated with the help of penalty factor. The cost for utilizing aerial bundled conductors in distribution systems has been compared with the cost of use of bare conductors.

Key words: Unserved energy, Aerial Bundled Conductors

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Section D

401/D

Antifeedant properties of endophytic fungi of *Cyperus iria* on *Plutella xylostella* (Diamond Black Moth) larvae

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Plutella xylostella is a destructive pest that affects cabbage cultivations in Sri Lanka causing economic loss. Continuous application of synthetic insecticides has produced environmental and health hazards, while the insects have developed resistance. Thus, there is a crucial need for new environmentally friendly alternatives. Endophytic fungi of grasses and sedges are known to possess insect repellent activities. Hence, this study was designed to investigate the antifeedant properties of endophytic fungi of the sedge, *Cyperus iria*, against *P. xylostella* larvae. Endophytic fungi were isolated from surface sterilized healthy tissues of *C. iria* and their ethyl acetate extracts were subjected to no choice leaf disc assay against *P. xylostella* 2nd instar larvae at 200 µg/cm². Feeding deterrence indexes (FDI) were calculated using the consumed area after 24 hr while larval mortality percentage was also evaluated by counting the number of dead larvae after 24, 48 and 72 hr of incubation. The experiments were conducted in triplicate and the data were statistically analyzed using Minitab 16. The isolated endophytic fungi, five from roots and twelve from aerial parts, were identified using molecular techniques. Out of these, five extracts showed high (FDI>60%), four extracts each, showed medium (30%<FDI<60%) and low ((FDI< 30%) feeding deterrence, while another four extracts exhibited feeding stimulant activity. The highest feeding deterrence was exhibited by *Khuskia oryzae* extract (FDI = 98%) while both *K. oryzae* and *Diaporthe miriciae* (FDI = 96.74%) extracts showed a similar antifeedant activity ($p>0.05$) to that of the positive control (neem-1% EC). *Schizophyllum commune* extract showed the highest feeding stimulant activity. Further, 66.67 % larval mortality was recorded for the *K. oryzae* extract while no larval mortality was recorded for *D. miriciae* extract, after 24 hr of incubation. Thus the highest feeding deterrence shown by *K. oryzae* extract may have aroused due to the mortality of the larvae. Therefore the best extract with antifeedant properties is *D. miriciae* while *K. oryzae* extract demonstrates good larvicidal properties. In conclusion, the potent antifeedant and larvicidal properties exhibited by several endophytic fungal extracts of *C. iria* demonstrate their potential to be developed as effective antifeedants and larvicides.

Keywords: endophytic fungi, feeding deterrence, leaf disc no-choice bioassay, *Plutella xylostella*,

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Assessing the environmental stress in the Diyawannawa wetland using macro-benthic molluscan diversity based Abundance-Biomass Curves

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The present study assessed the variation of macrobenthic molluscan abundance and biomass with spatial variation of water and shallow sediment quality parameters in the rehabilitated and non-rehabilitated regions of the Diyawannawa wetland. Six sampling sites, reflecting various land uses in the non-rehabilitated (Site A,B,C) and rehabilitated (Site D,E,F) areas of the Diyawannawa wetland, were selected. At each site, DO, nitrate concentration, total phosphate (TP) concentration, BOD₅, COD, chlorophyll-a (Chl-a) concentration of water, sediment conductivity, sediment pH, sediment percentage organic matter (%OM), sand%, silt%, clay%, and abundance and biomass of macrobenthic molluscs were recorded. Sampling was done from April to October 2016. One way ANOVA followed by Tukey's pairwise comparison was used to assess the spatial variation of water and sediment quality parameters. The correlation between macrobenthic mollusc abundance and water and sediment quality parameters were determined by Pearson's correlation analysis. Abundance-Biomass Comparison (ABC) Curves of molluscs were plotted. The significantly high mean abundance of *Bithynia tentaculata* (35), *Melanoides turbeculata* (5), *Lamellidens marginalis* (3) and *Pila globosa*(2) were recorded in site F, of the rehabilitated area where there was a significant input of solid waste, runoff sediments and organic matter. A significant spatial variation of nitrate N, COD, BOD₅, Chl-a, DO, % sand, % OM, sediment pH, and conductivity was recorded in rehabilitated sites. Significantly high mean nitrate, Chl - a, COD, and % OM were recorded in site F. *Bithynia tentaculata* and *Pila globosa* showed a significant positive correlation with shallow water Chl - a, nitrate content, TP, COD and BOD₅; *Bithynia tentaculata* was the biomass dominant species in all sampling sites. The highest and lowest percentage of biomass of *Bithynia tentaculata* was recorded in Site F (78.13 %) and in Site B (41.40%) respectively. The ABC curves indicated Site A as a typical unstressed site while Site F as a heavily stressed site. All the other sampling sites were moderately stressed and the level of disturbance varied among the sites. Further based on water and sediment quality data, it can be concluded that most of polluted sites (Sites E and F) are in moderate to heavily stressed condition, while comparatively less polluted sites (Sites A to D) are in unstressed to moderate stressed condition.

Keywords: *Bithynia tentaculata*, Abundance biomass curves, correlation, Water quality.

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403/D

Investigating Actinomycetes for Antimicrobial Activities

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Prolific production of bio-active secondary metabolites has made actinomycetes an important group of microorganisms to humans, because they contribute to nearly 80% of clinically important antibiotics. This study aims at investigating actinomycetes isolated from terrestrial and fresh water habitats for their antimicrobial potential towards a range of microorganisms and identifying active isolates using morphological characteristics and molecular techniques. A total of 108 actinomycetes were isolated using starch casein agar as the selective medium upon different pretreatments such as air drying, chemical, and heat pretreatment. Their identity was primarily confirmed based on Gram reaction and morphological features, especially of spores and spore arrangement. Crude extracts in ethyl acetate of 19 selected isolates (based on rapid growth), grown in starch casein agar broth for 5 days, were subjected to screening against *Bacillus subtilis* ATCC[®]11778TM, *Escherichia coli* ATCC[®]25922TM, *Pseudomonas aeruginosa* ATCC[®]25353TM, *Staphylococcus aureus* ATCC[®]25923TM, and *Candida albicans* ATCC[®]90028TM. The disc diffusion technique was conducted in triplicate using Ciprofloxacin (antibacterial) and Ketoconazole (antifungal) as positive controls (concentrations of antibiotics and crude extract as per 1 mg/disc). Diameters of inhibition zones were measured and 12 isolates showed antifungal activity against *C. albicans* and broad spectrum antibacterial activity against Gram positive and negative bacteria (except *E. coli*). Three of these isolates showed strong inhibitory activity, importantly a higher growth inhibition compared to that of Ketoconazole. None of the isolates were antagonistic towards *E. coli*. Nine isolates having considerable inhibitory activity were selected for further identification using molecular techniques. Actinomycetes were grown in starch casein agar broth for 4-5 days for DNA extraction and 16s rRNA gene (16s rDNA sequence) from extracted DNA was amplified using the universal primer pair 27F and 1492R, by PCR. Three of the actinomycete Isolates identified by using molecular techniques are *Actinobacteria* bacterium strain nenu_DS_12, *Streptomyces pseudogriseolus* strain 173735, and *Nocardiopsis flavescens* strain BF10 (Accession numbers are KY009689.1, EU570428.1 and KU973973.1, respectively). Respective sequences were deposited in the NCBI repository. In conclusion it can be mentioned that 12 isolates tested above have the potential to be developed as sources of novel antimicrobial compound/s of clinical importance.

Keywords: secondary metabolites, antibiotics, actinomycetes, antimicrobial compounds, disc diffusion technique.



404/D

Application of Direct Toxicity Assessment Technique for Assessing Potential Ecological Impacts of Rubber Industry Effluents Reaching Kalu River, Sri Lanka

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The rubber processing industry is one of the major water polluting industries in Sri Lanka. This study applied the Direct Toxicity Assessment (DTA) technique using aquatic organisms belonging to different trophic levels, viz., *Lemna perpusilla* (plant), *Daphnia magna* (crustacean), and *Poecilia reticulata* (fish), and physico-chemical analysis in order to evaluate the potential ecological impacts associated with rubber industry effluents reaching the Kalu River. Treated effluent samples (Effluent A: Crepe rubber manufacturing industry and Effluent B: Technically specified rubber manufacturing industry) were collected in dry and wet periods in 2016 from the effluent receiving points. The test organisms were exposed in the laboratory to undiluted and diluted effluents following standard toxicity testing procedures. Toxicity thresholds were estimated statistically by probit analysis with 95% confidence limits. Physico-chemical analysis showed that the effluents in some cases exceeded the specified tolerance limits for discharge of rubber industry effluents (pH, total solids, total suspended solids, BOD₅, COD, total nitrogen and sulphides) into inland surface waters. Based on DTA, estimated toxicity thresholds of the effluents were significantly lower ($P=0.05$) in the dry period compared to the wet period. In the dry period, estimated EC₂₀ values for 7 days growth inhibition of *L. perpusilla* exposed to effluents A and B were 27% and >100% respectively. Estimated EC₂₀ values for 48 hour immobilization test of *D. magna* exposed to effluents A and B were 3% and 16% respectively. LC₂₀ values for 96 hour mortality of *P. reticulata* exposed to the effluents A and B were 7% and 28% respectively. Considering the toxicity thresholds, *D. magna* is the most sensitive organism for rubber effluent exposure. Hence, the estimated dilution of the effluents A and B should be at least 3% and 16% respectively in the dry periods in order to protect sensitive species in the receiving waters under short term exposure. Yet, effluents should be subjected to further dilution considering potential health impacts under chronic exposure. The study highlights the importance of applying DTA at industry levels in regulating rubber industry effluents that are discharged into important water resources.

Keywords: Direct Toxicity Assessment, Kalu River, Rubber industry effluent, Water pollution

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405/D

Assessment of growth and phytoremediation potential of *Eichhornia crassipes*, *Salvinia molesta*, and *Pistia stratiotes* for the removal of Total Dissolved Solids and Electrical Conductivity in sludge of common waste water treatment plant at Biyagama EPZ

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Phytoremediation is an environmentally friendly, low cost, promising technique for the removal of TDS and EC in sludge generated from industrial waste water treatment plants. The efficiency of TDS and EC removal by plants mainly depends on the tolerance of plants to the medium and their uptake capability. The present study was planned for the sludge generated from the common waste water treatment plant (CWWTP) at Biyagama EPZ. Since raw sludge caused 100% mortality of *Eichhornia crassipes*, *Salvinia molesta* and *Pistia stratiotes*, raw sludge was diluted for the study. Thus, the objective of the study was to assess the plant growth and removal of TDS and EC by above species at different sludge dilutions. The sludge was diluted with de-chlorinated tap water to obtain 1:10, 1:6.67, 1:5, 1:4, 1:3.33 and 1:2.5 dilutions. Similar weights of acclimatized young plants of each species were placed in above dilutions simultaneously. Triplicate samples were maintained for 28 days. The plants were harvested at the end of the experiment to obtain the wet weight. TDS, EC and pH of the medium were measured every 7 days using a HACH HQ 40d Multi-Para Meter. Data were subjected to One-Way ANOVA followed by Tukey's pairwise comparison tests using MINITAB (version 14.12.0). Results revealed that *E. crassipes* at 1:10 dilution showed a significant maximum relative growth rate ($0.025 \text{ gg}^{-1}\text{day}^{-1}$; $p=0.000$). Both TDS and EC in the medium with *E. crassipes* at 1:10 dilution reduced with increased exposure time. *E. crassipes* showed a significant maximum reduction of TDS (54.0%; $p=0.000$) and EC (60.0%; $p=0.019$) at 1:10 dilution by day 28. In addition, *S. molesta* and *P. stratiotes* showed the maximum reduction of TDS (37.7% and 37.3% respectively) and EC (44.3% and 51.8% respectively) at 1:6.67 dilution. Moreover, TDS and EC reduction by all species were accompanied by an increase in pH. Altogether, the results suggested that *E. crassipes* is the best in reducing TDS and EC in the sludge generated at CWWTP at Biyagama EPZ.

Keywords: *E. crassipes*, Biyagama, Total Dissolved Solids, Electrical Conductivity, plant.

Acknowledgment: Financial assistance by 15-147 of National Research Council, Sri Lanka.



406/D

Antioxidant potential of traditional kurakkan (*Eleusine coracana*) thalapa meal and kollu (*Macrotyloma uniflorum*) curry

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Antioxidants play an important role in the body's defense system against reactive oxygen species (ROS), the harmful by-products generated during normal cell aerobic respiration. This study aimed to assess the antioxidant potential of Kurakkan (*Eleusine coracana*) thalapa meal and of kollu (*Macrotyloma uniflorum*) curry given as an accompaniment and of raw flour of both Kurakkan and Kollu. DPPH radical scavenging activity, ABTS radical cation decolouration activity, and total phenolic content (TPC) by Folin-Ciocalteu assay were used to determine the antioxidant potential. Total phenolic content was determined with both methanol and phosphate buffer (pH 7) extracts (2.5 g extracted with 35 mL of methanol or buffer for 30 min).

In both ABTS and DPPH assays, phosphate buffer extractions showed significantly ($p < 0.05$) higher antioxidant activity than the methanolic extracts (low IC_{50} values). Phosphate buffer extracts of both samples showed significantly greater ($p < 0.05$) inhibitory activity against ABTS radicals than the DPPH radicals when compared with the standard, Trolox (2.9 ppm) and ascorbic acid (2.7 ppm) respectively. When considering raw flour and the cooked meals, the raw flour (both Kurakkan and Kollu) had significantly higher ($p < 0.05$) antioxidant activity than the phosphate buffer extractions (low IC_{50} values), thus indicating heating may be detrimental to the antioxidant compounds present in these raw flours. The total phenolic content of both methanolic and phosphate buffer extracts were lower when compared with standard Gallic acid indicating the contribution to antioxidant potential by both these food items may not be very high. Table 1 below shows the summary of the results of Total phenolic and antioxidant potential of the cooked and raw kurakkan and kollu.

Table 1: Total phenolic and antioxidant potential of the cooked and raw kurakkan and kollu

		TPC	Antioxidant potential	
		GAE equivalents	DPPH IC_{50} value (ppm)	ABTS IC_{50} value (ppm)
Kurakkan flour	Methanol	1.28	20.6 ^b	1621 ^c
	Phosphate buffer	1.94	9.7 ^c	461 ^a
Kurakkan thalapa	Methanol	1.28	40 ^a	4874 ^a
	Phosphate buffer	1.04	19 ^a	405 ^b
Kollu flour	Methanol	0.93	16 ^c	2426 ^b
	Phosphate buffer	0.87	7 ^d	474 ^a
Kollu curry	Methanol	0.80	37 ^a	1621 ^c
	Phosphate buffer	1.16	17 ^b	482 ^a

Keywords: Kurakkan, Kollu, Antioxidant, DPPH (2, 2'-diphenyl-1-picrylhydrazyl), ABTS (2, 2'-azinobis (3-ethylbenzothiazoline 6-sulfonate)), Total phenolic content (TPC)



407/D

Magnetite-bearing boulders from Belihuloya area, Balangoda

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Some boulders rich in magnetite were found in the Belihuloya area, Balangoda. As ancient iron smelting sites are located in this area, these magnetite-bearing boulders cast doubt on the exact iron ore source used, as such is unknown to date with certainty. As this is the first discovery of these magnetite-bearing rocks, no detailed study has yet been done. Therefore, this study aims to reveal the occurrence and petrography of these rocks. A petrographic study and magnetite weight percentage analyses were carried out on rock samples which were collected during the field work. Fifteen thin sections were prepared for petrographic analyses. Those thin sections prepared were then studied under a polarizing microscope. Magnetite was separated from finely ground rock powder in selected samples using a hand magnet, and magnetite weight percentages were calculated using gravimetry. The boulders, ranging in size about 0.3 – 0.6 m, occur overlying the weathered bedrock at two main locations which are 1.5 kms apart. In hand specimen, coarse magnetite grains (0.5 – 1 cm) are clearly visible, and occur in a foliated texture. In thin section, magnetite shows disseminated and elongated grains varying in size. A relatively large amount of magnetite occurred in two rock samples from one of the two locations and in close association with quartz, sillimanite, and spinel. Other rock samples, which were from both locations, contain moderate to low amounts of magnetite associated with sillimanite, garnet, biotite and feldspar. Weight percentage analyses indicate that the rocks contain magnetite varying from 4-5 wt% to 27-30 wt%. Thus, the samples studied contain a relatively high amount of magnetite wt%. The boulders are likely transported. They can be grouped into two rock types as (1) magnetite rich foliated quartzite and (2) magnetite-bearing pelitic gneiss. Textural features of the foliated quartzite and pelitic gneiss containing magnetite suggest a metasedimentary origin for the iron ore. To our knowledge, such high amounts of magnetite-bearing rocks have not been previously reported. Importantly, these rocks could be one of the potential sources for the ancient iron smelting industry, which prevailed in the Belihuloya area.

Keywords: Iron ore, Iron smelting, Magnetite, Magnetite-bearing rocks

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408/D

Effect of Rhythmic Buddhist Chanting (*Pirith*) and Pop Music on Growth Performance of *Codariocalyx motorius* (Houtt.) H. Ohashi

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Music affects the growth of plants by either promoting or restricting the growth of plants. The response of *Codariocalyx motorius* to Pop music and *Pirith* chanting was examined by conducting a laboratory experiment. Three (03) months old *C. motorius* saplings were kept in a sound proof confined chamber in Botany Research Laboratory, The Open University of Sri Lanka, Nawala, Sri Lanka. The saplings were planted in plastic pots filled with a mixture of compost and soil, up to $\frac{3}{4}$ of the total depth. Completely Randomized Design (CRD) was used with five replicates. One week after planting, plants were exposed to three treatments; Pop music, *Pirith* (*Thunsuthra*) and silence served as the control. Music and *Pirith* were played separately for an hour, 30 cm distance away from the plants with a sound level of 58 – 63 dB for two months continuously, maintaining equal environmental conditions. Measurements on plant height, number of leaves, number of branches, leaf area, leaf width, leaf length, number of leaflets, and chlorophyll content per plant were taken once every two weeks. The percentage difference of the parameters was calculated and data were analyzed using ANOVA. Significant differences ($p < 0.05$) between the treatment of *Pirith* and pop music were observed for plant height, leaf width, leaf area, chlorophyll content and leaflet length. The magnitudes of the percentage difference between measured parameters of *C. motorius* under *Pirith* chanting and pop music indicated that there was discernible effect of *Pirith* chanting on the measured plant parameters in the study. The results of the study revealed that the rhythmic chanting of *Pirith* is the most appropriate rhythmic sound pattern that improved the growth performance of *C. motorius*, attributing to increases the metabolism when appropriate tune is played.

Keywords: *Codariocalyx motorius* (Houtt.) Ohashi, *Pirith*, Pop music, 'Pranajeewa.'

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409/D

Screening for cyclotides and antibacterial studies for selected medicinal plants of families Fabaceae, Violaceae and Curcubitaceae.

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The Sri Lankan Ayurvedic system of traditional medicine derives from plant-based remedies handed down from generation to generation over a period of 3000 years. Cyclotides, gene encoded proteins, are exceptionally stable, and have a wide range of biological activities such as antimicrobial, anti-HIV, antineurotensin, cytotoxic and hemolytic activities. The current project was conducted to screen for cyclotides and antibacterial studies of selected Sri Lankan medicinal plants belong to families Fabaceae, Cucurbitaceae, and Violaceae. The plants were chosen based on their ethno pharmacology values. Collected plant parts were pulverized and extracted to Dichloromethane and Methanol 1:1 (v/v) mixture. This total crude extract was then subjected to agar disc diffusion assay in order to find the antibacterial active extracts. Also all crude extracts were subjected to solvent-solvent extraction. From this, organic and aqueous crude extracts were obtained. The aqueous extract was subjected to cyclotide screening by carrying out liquid chromatography-mass spectrometry (LC-MS) analysis. Cyclotides were detected by their late retention times on reverse phase high-performance liquid chromatography (RP-HPLC) and molecular masses between 2.8 and 3.8 kDa. Fabaceae(27), Cucurbitaceae (4), and Violaceae (4) plants were screened using the above method. Out of all plants screened only two plants in the Violaceae family, *Viola pilosa* and *Viola beneticifolia* showed the presence of cyclotides. According to our knowledge this is the first reporting of cyclotides in Sri Lankan plants. Further experiments were conducted to check the antibacterial activity of those plants. 13 plants out of 35 showed antibacterial activity against *Staphylococcus aureus* and *Bacillus cereus* in the agar disc diffusion assay. Interestingly, all of the plants in the assay showed activity against gram positive strains, and none of the plants showed activity against gram negative strains (*Escherichia coli* and *Pseudomonas aeruginosa* were tested).

Keywords: Ayurvedic, Antibacterial, Cyclotides.

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410/D

Comparison of the fecal indicator bacteria in sand collected from three different tidal zones in a beach from West coast of Sri Lanka

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Beach visitors, especially children tend to spend more time in contact with the sand and therefore the sanitary quality of sand serves as a vital part of an effective coastal management system. Assessment of fecal indicator bacteria in marine environments provides useful information regarding the possible contamination of beaches with fecal pathogens. However, there is no international or national standard for the microbiological quality of beach sand. This study was aimed at carrying out the microbiological quality assessment of sand at a popular bathing site in the Western coast of Sri Lanka. Sand samples were collected across three tidal zones; sub tidal zone (wet sand), inter tidal zone (shoreline sand) and supra tidal zone (dry sand). Fecal indicator bacteria namely; total coliforms, thermo-tolerant coliforms, *E. coli*, fecal streptococci and *Enterococcus* levels were estimated during this study using standard microbiological procedures given for marine water. The fecal indicator bacteria were detected and enumerated using the most probable number technique. The statistical analysis was performed using Minitab 18 program. The results indicated that shoreline sand has higher total coliform counts (3153 MPN/100 g) than both wet (2171 MPN/100 g) and dry sand (1217 MPN/100 g). Thermo-tolerant coliforms were also high in shoreline sand (2745 MPN/100 g) but *E. coli* was high in wet sand (1029 MPN/100 g). Fecal streptococci and enterococci levels were higher in wet sand than the other two types of sand. Sanitary quality of sand based on *E. coli* decreased from dry sand, shoreline sand to wet sand. But based on total coliforms, it decreased from shoreline sand, wet sand to dry sand. The statistical analysis revealed that there were some correlations among fecal indicator bacterial densities within the same tidal zone. In dry sand, enterococci counts were positively correlated with *E. coli* and total coliforms ($p < 0.05$). But there was no significant correlation of these organisms present in the shoreline and wet sand. However the results indicated that bacterial densities of the indicator organisms used in this study comply with the limits given in the proposed Portuguese guideline for the microbiological quality of sand. Based on these results, this selected beach area was determined to be "good." However, the microbiological quality of the beach area is necessary to be monitored using both sea water and sand.

Keywords: Beach sand, *E. coli*, enterococci.

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411/D

Isolation of antibiotic resistant bacteria from different waste sources and determination of their level of resistance.

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The use of antibiotics as feed additives or growth promoters for livestock, is popular in animal farming. The selective pressure exerted by such measures may induce resistance to antibiotics among bacterial populations and promote the dissemination of antibiotic resistance in the environment through animal manure. Apart from that, antibiotics can be released into the environment through waste water treatment plants in pharmaceutical industries, which could also promote the selection of antibiotic resistant bacteria. The antibiotic resistant gene cassettes of bacteria may be found within the bacterial chromosome or in mobile genetic elements. Antibiotic resistance conferred within the mobile genetic elements is considered important, as they are easily subjected to horizontal gene transfer, resulting in new resistant varieties. The gene cassettes may contain gene sequences responsible for the resistance of one or more antibiotics and heavy metals. In this study, we have used animal manure collected from two different farms (the veterinary teaching farm of the University of Peradeniya and a private farm in Colombo) and waste water samples collected from a pharmaceutical industry located in Colombo area, to isolate antibiotic resistant bacteria. In order to determine their level of resistance to selected antibiotics (ampicillin, tetracycline, chloramphenicol and kanamycin) and heavy metals (Cu, Cd, Ni and Cr), disk diffusion test was carried out according to the Kirby-Bauer technique in the presence of different concentrations of the antibiotics and heavy metals. Plasmid profiles of the isolated bacterial cultures were analysed using standard plasmid extraction procedures. According to the results obtained, bacterial isolates exhibited varying degrees of resistance to the antibiotics tested. Out of the thirteen bacterial isolates isolated in this study, JM1 was resistant to all the different concentrations of three of the four antibiotics used. Isolate PF-M, which was isolated through multiple drug enrichment steps, exhibited resistance to all the concentrations of antibiotics and heavy metals used. All isolates contained plasmids >10 kb in size. However, further studies are required to determine whether the antibiotic resistant gene cassette is plasmid conferring or not.

Keywords: Antibiotic resistance, Horizontal gene transfer, Resistome

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412/D

Presence of heavy metals and polycyclic aromatic hydrocarbons in the atmosphere of Kandy City and associated health risks

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The presence of heavy metals (HMs) and polycyclic aromatic hydrocarbons (PAHs) in atmospheric deposition was investigated for nine sampling sites in Kandy, Sri Lanka, which is a typical city in the developing world with significant traffic congestion. Deposition samples were analyzed for Al, Cr, Mn, Fe, Ni, Cu, Zn, Cd, and Pb, which are HMs common to urban environments, following the method of USEPA 200.8. *Crocynia pyxinoidea*, a lichen species was also analyzed from same sampling sites. USEPA priority 16 PAHs were analyzed following the method of USEPA 610. Human and ecological health risks were assessed using risk indexes, while the cancer risk was evaluated based on life time daily cancer risk. Al and Fe were found in high concentrations (0.007 – 115.4 mg/m²/day) due to the presence of natural sources, but may also be re-suspended by vehicular traffic. Relatively high concentrations of toxic metals such as Cr and Pb were also found (0.5 and 0.65 mg/m²/day respectively). High Zn loads can be attributed to vehicular emissions and Zn coated roofing materials. The metal concentrations among the sampling sites significantly differ (p<0.001) depending on the traffic conditions. Only five PAHs, namely, Phenanthrene, Anthracene, Fluoranthene, Pyrene, and Napthalene were found in deposition loads. The changing patterns of HMs were similar in both lichen and deposition samples as Fe>Al>Zn>Pb>Mn>Cu>Cr>Ni> Cd. Contamination factor and geo-accumulation index showed that Al and Fe are at uncontaminated levels currently and other metals are in the range of uncontaminated to contaminated levels, but with the potential to become exacerbated in the long-term. The risk values for children (for Fe, HI-0.58) were higher than that for adults (for Fe, HI-0.06), indicating that children may be subjected to potentially higher health risks. Regarding PAHs, all the cancer risk values are above the acceptable levels. The ecological risk levels on HMs were also higher, with Cd responsible for the highest ecological risk. The study provided fundamental knowledge to determine appropriate mitigation measures in relation to HM and PAH pollution in city environments in the developing world, where to-date only very limited research has been undertaken.

Keywords: Heavy metals, polycyclic aromatic hydrocarbons, deposition, human health risk, ecological risk, Kandy City.

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413/D

Metal release and soil nutrient levels of serpentine soils under two different soil water status and different soil amendment levels

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Serpentine soils which originated through pedogenesis of ultramafic rocks have the potential to release high concentrations of heavy metals, including Ni, Mn, Cr, and Co, into the surrounding environment. Different soil water statuses, different soil amendments, and amendment ratios can affect the amount of release of these heavy metals from serpentine soil particles. Two sets of serpentine soil samples, each consisting of the control (serpentine soil only), soil + 2.5% dendro-biochar (DB), soil + 2.5% DB + 1% municipal solid waste compost (COM), soil + 2.5% DB + 2.5% COM, and soil + 2.5% DB + 5% COM, were incubated under two different soil water statuses: Saturated point (SP) and Field capacity (FC). After 10 days of incubation, sub samples from each treatment were tested for bioavailability of heavy metals: Ni, Mn, Co, and Cr using DTPA extraction procedure followed by AAS. Using standard colorimetric procedures, available P, available N and total organic carbon (TOC) concentrations of each treatment were also determined. Significantly, the highest concentrations ($P < 0.05$) of three heavy metals (*i.e.*, Ni, Mn, and Co; 129.20, 71.40 and 5.88 mg/kg respectively) were present in the treatment of 'no amendment added,' which was incubated at saturated point. However the soil incubated under field capacity with the highest amendment ratio (2.5% DB + 5% COM) showed highest reduction of Ni, Mn, and Cr (65.4, 68.3 and 100.0% respectively) compared to the highest concentration reported. Also this highest amendment ratio involved the highest concentrations of available N, available P and TOC. Moreover the saturated soil water status is much more favorable for the availability of P and TOC, whilst field capacity is favorable for the availability of N.

Key words: Heavy metal, Soil amendment, Soil water level, Plant nutrients, Ussangoda.

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414/D

**Diurnal activity budget of endemic Dull-blue Flycatcher *Eumyias sordidus*
(Passeriformes: Muscicapidae) in Horton Plains National Park, Sri Lanka**

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The diurnal time-activity patterns of the Sri Lanka Dull-blue Flycatcher *Eumyias sordidus* were studied during January to December, 2016, in Horton Plains National Park (HPNP). Focal sampling method was used to study the activity of *E. sordidus*. A total of 288 hours were spent to collect data. Three natural habitats were selected for study namely Cloud Forest (CF), Cloud Forest Die-back (CFD) and Grassland (GL). To test the differences in activities in an entire daylight period, each day was divided into different time periods, Early Morning (EM), Morning (M), Midday (MD), Afternoon (AN) and Evening (E). The Climate seasons were characterized as First Inter Monsoon Season (FIMS), South West Monsoon Season (SWMS), Second Inter Monsoon Season (SIMS), North East Monsoon Season (NEMS). One-way ANOVA test was used to check the significant difference among variables. Dull-blue flycatchers spent an average of 33.54% of their day time for scanning, 3.18% feeding, 4.77% locomotion, 20.55% resting, 14.28% vocalizing and 6.18% engaging in preening activities. The time spent on resting (ANOVA, $p=0.021$), preening (ANOVA, $p=0.022$), vocalizing (ANOVA, $p=0.045$) and breeding (ANOVA, $p=0.037$) varied among climate seasons in 2016. The time spent on scanning (ANOVA, $p=0.014$), locomotion (ANOVA, $p=0.018$), resting (ANOVA, $p=0.021$) preening (ANOVA, $p=0.016$) and other activities (ANOVA, $p=0.011$) varied among time periods during the day, but not among habitats (ANOVA, $p>0.05$). The time spent for vocalizing varied among habitats (ANOVA, $p=0.044$) and climate seasons (ANOVA, $p=0.045$) within the year. The feeding patterns did not differ among climate seasons, day time periods and habitats (ANOVA, $p>0.05$). Locomotion behaviour varied among day time periods (ANOVA, $p=0.03$) but did not change between seasons and habitats (ANOVA, $p>0.05$). The resting behaviour differed among climate seasons (ANOVA, $p=0.021$) and day time periods (ANOVA, $p=0.012$) but did not differ among habitats (ANOVA, $p=0.214$). Preening differed among seasons (ANOVA, $p=0.022$) and day time periods (ANOVA, $p=0.021$) but did not vary among habitats (ANOVA, $p=0.118$). Breeding activities were observed during FIMS and SWMS. *E. sordidus* spent an average of $49.9 \pm 12.7\%$ (Mean \pm Standard Deviation) of their day time for breeding activities during breeding seasons. The current research suggests that several factors, such as food availability, environmental conditions, predation threat and human disturbances may affect the diurnal activity patterns of *E. sordidus* between day time periods, habitats and climate seasons in HPNP. The present study provides insights for the conservation of this endemic bird species, and recommends further studies to clarify the conclusion.

Key Words: Sri Lanka Dull-blue Flycatcher, Endemic, Horton Plains, Diurnal activity budget, Tropical Montane Cloud Forest.

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415/D

Nest Site Selection of Sri Lanka Yellow-eared Bulbul (*Pycnonotus penicillatus*) in Horton Plains National Park

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The Sri Lanka Yellow-eared Bulbul (*Pycnonotus penicillatus*) is a member of the Family Pycnonotidae of Order Passeriformes. It is an endemic bird, assessed under IUCN global conservation status of Near Threatened (NT) category, and national conservation status of Vulnerable (VU) category in National Red List. Their nest is more substantially built than the other bulbul nests. This research was conducted from September 2015 to June 2017 in the Horton Plains National Park (HPNP) situated in the Central highlands. The aim of this study is to determine nest site selection of *P. penicillatus*. Three habitats were selected within HPNP as Cloud Forest, Cloud Forest Die-back and Human-induced habitat. Nests were located by following individuals and searching the vegetation. The location of the nests were marked by a GPS. Tree species, nest height, and diameter at breast height (DBH) were measured, after the birds left the nest. Vegetation structure was estimated by observing the surrounding vegetation. Nest concealment in three dimensional directions was measured by using a spherical densiometer. The distance from the nest tree to the adjacent tree, nearest road or walking path was measured. Disturbances affecting the nests were observed and recorded. In this study thirty eight (38) nests were observed. In the Cloud Forest habitat 29 nests were successful, two nests were disturbed at the final stage of construction and one nest was destroyed after completion. The nest which was recorded from the Cloud Forest Die-back habitat was successful. Two nests from the Human induced habitat were disturbed and three nests were destroyed. Furthermore, *P. penicillatus* preferred twelve plant species to construct their nests, including seven endemic tree species. *Berberis ceylanica* was the major nesting plant. They used to construct their nests at a height of $2.67 \pm 1.21\text{m}$ in trees of $4.43 \pm 3.04\text{m}$. The relative height was 0.66 ± 0.18 which means the nests were located near canopies. The DBH was 14.09 ± 12.86 cm. Nest concealment was $37.11 \pm 25.80\%$. They highly preferred medium sized trees which were situated at densely packed habitats. They constructed their nests away from human disturbances. The present study reveals that Cloud Forest habitat as the most suitable habitat to construct the nests of *P. penicillatus*. It is important to warrant the protection Cloud Forest habitat and endemic tree species for the assurance of *P. penicillatus* for future generations.

Key words: Nest site selection, *Pycnonotus penicillatus*, Horton Plains National Park.

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416/D

**Effect of blood meal source on feeding preference, fecundity and egg hatching success of
Aedes aegypti (L.)**

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Oogenesis of non-autogenous mosquitoes solely depends on the hematophagy (blood feeding behaviour) of female mosquitoes. Apart from the regular sugar meal, female mosquitoes feed on blood of vertebrate hosts to acquire nutrition required for oogenesis. Success of hematophagy depends on the host seeking behaviour of female mosquitoes, which is governed by the host preference displayed by mosquitoes and by their host seeking ability. Host preference is believed to be due to the nutritional benefits mosquitoes gain, by feeding preferentially on certain blood sources over others. The aim of the current study was to identify the feeding preference and the effect of the different blood sources on reproductive success of *Aedes aegypti*. Five different blood sources, viz., human, cattle, rabbit, sheep, and dog, were given to laboratory reared colonies of *Aedes aegypti* with the use of an artificial membrane feeding system. The feeding behaviour of mosquitoes was observed, and the eggs laid by female mosquitoes fed on each blood meal source were counted. The eggs were allowed to hatch separately. The number of female mosquitoes approaching the blood meal within the first fifteen minutes, and the successfully fed percentage after every blood meal was used to determine the feeding preference. The number of eggs laid per female mosquito during first gonotrophic cycle was taken as the fecundity. All eggs were allowed to hatch separately to determine the mean egg hatching percentage. Each trial was replicated eight times. It was observed that mosquitoes displayed significantly higher preference for human blood over other blood meal sources, and the average number of eggs laid by a female mosquito, the fecundity, fed on human blood, (104 ± 4.8 , $P < 0.05$) was significantly higher over other blood meal sources. The mean percentage of egg hatching for human blood (83.6 ± 0.3) and for cattle blood (81.8 ± 0.2) were not significantly different ($P > 0.05$) from each other, while those values were significantly different from the values resulted for other given blood meal sources: rabbit (74.8 ± 0.2), sheep (51.7 ± 1.3) and dog (27.8 ± 1.2). According to the results obtained, it can be safely concluded that *Aedes aegypti* feed preferentially on human blood, while the source of the blood meal had an effect on fecundity, whereas the egg hatching percentage remain unaffected from the source of blood meal.

Key words: *Aedes aegypti*, blood meal source, feeding preference, fecundity.

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417/D

Detecting of Knock Down Resistance (*kdr*) F1534C Allele in the Dengue Vector *Aedes aegypti* in Colombo South Peri-Urban Areas

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A *phenylalanine* (F) to *cysteine* (C) substitution at position 1534 within the third domain of the NaV is associated with resistance to the type I pyrethroid, permethrin, among populations of *Aedes aegypti*, the main vector for the dengue virus. Eggs were collected from three dengue high risk MOH areas in Colombo district. Samples were reared to adulthood and their resistance status against permethrin was determined by standard WHO susceptibility bioassays. Permethrin-resistant insects were then genotyped for the F1534C mutation. All the PCR products were separated on 3.5% agarose gel and visualized by UV trans-illumination. Overall susceptibility was 58.3%, with mortality rates varying widely from 12.0 % to 61.0%. Samples obtained from all three sampling sites showed high degrees of incipient resistance (<80% mortality). There was no mortality among control mosquitoes. Amplicons of approximately 90 and 110 bp, corresponding to alleles 1534 Phe⁺ and 1534 Cys^{kdr} respectively, were observed in all the resistant genotypes. The highest C allele frequency (0.847) was obtained from Nugegoda, Gangodawila PHI area, and the lowest C allele frequency (0.543) was obtained from Dehiwala, Nedimala PHI area. The C allele frequency obtained from Maharagama, Jambugasnulla PHI area was in between (0.657). The 1534C mutation was significantly and positively associated with permethrin resistance in the selected areas of Sri Lanka. However, the resistance in these populations cannot be explained only due to *kdr* mutations and indicates that other resistance mechanisms are also operating. The results of the present study would help health authorities to use appropriate insecticides in each administrative area to delay the onset of resistance and to use appropriate insecticides to get the maximum effect through space spraying.

Keywords: knock-down resistance (*kdr*), voltage gated sodium channel (NaV), permethrin, *Aedes aegypti*, dengue, resistance, mutation, Sri Lanka

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418/D

Promoter hypermethylation of *TIMP3* and *PCQAP 5'* tumour suppressor genes in saliva of oral and oropharyngeal cancer patients: A pilot study in Sri Lanka

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Epigenetic and genetic alterations play a major role in the development of oral and oropharyngeal cancers (OOPC). Epigenetic alterations, such as DNA methylation events are frequently accompanied by the excessive consumption of tobacco (smoking/chewing) and alcohol, which are strongly associated with an increased risk of OOPC incidence. Previous studies showed that silencing of tumour suppressor genes (TSGs) by DNA promoter hypermethylation is an early event of OOPC carcinogenesis. The current study aimed to evaluate the degree of the methylation level in the promoter CpG islands of *TIMP3* and *PCQAP 5'* TSGs in saliva derived DNA. Using a sensitive methylation-specific PCR (MSP) coupled with densitometric analysis, the current study recorded a marked elevation of the promoter methylation level in both *TIMP3* and *PCQAP 5'* TSGs ($p < 0.05$ for both TSGs) in saliva collected from OOPC patients ($n=60$) compared to normal healthy controls ($n=60$). Aberrant methylation of at least one of the TSGs was detected in 80% (48/60) of OOPC tumours; 86% (52/60) at *TIMP3* and 72% (43/60) at *PCQAP 5'*. Tumour cell specific promoter hypermethylation of both TSGs was presented in all OOPC tumour grades and stages while *TIMP3* promoter hypermethylation was significantly higher in poor to undifferentiated ($p < 0.05$) than in moderate to well differentiated OOPC ($p > 0.05$). The effect of established risk factors on promoter hypermethylation and relative odds ratios (OR) were assessed using a binary logistic regression analysis (IBM-SPSS Inc). Overall, a significant correlation ($p < 0.05$) was noted between positive betel quid (with tobacco) chewing history and promoter hypermethylation of both TSGs (*TIMP3*; OR=3.5, *PCQAP 5'*; OR=3.0). In conclusion, the study demonstrated that TSG promoter hypermethylation can be detected by the MSP analysis of DNA extracted from saliva collected from OOPC patients. These signature candidates of hypermethylated TSGs may function as potential diagnostic biomarkers for OOPC in Sri Lanka.

Keywords: Oral and oropharyngeal cancers, saliva, Epigenetics, Promoter hypermethylation.

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419/D

Molecular and biological aspects of Kawakawa (*Euthynnus affinis*) from the coastal waters of Sri Lanka

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Acquisition of fishery data and information on the biology and reproduction of fish is very important for the management of the fishery industry. Kawakawa (*Euthynnus affinis*) is one of the most important neritic tuna species found in commercial fish catches of Sri Lanka. It contributes 18% to the total tuna and tuna-like fishery of Sri Lanka. Gillnet is the major fishing gear used for this fishery, with 54% of the Kawakawa catch being from gillnets. This study was undertaken to collect information on morphometrics, feeding, and spawning of Kawakawa, and for the molecular identification of the species found in Sri Lankan waters. A total of 330 samples were collected monthly from October 2015 to March 2017 from Mirissa, Weligama, Galle, Dodanduwa, Beruwela, Negombo, Chilaw, Kalpitiya, and Trincomalee. The total lengths of the samples collected ranged from 17.9 to 63.3 cm and the weights ranged from 76.2 to 3,590.7 g. The total length range in which the highest number of fish had been sampled was 44.1 to 46.0 cm. The length weight relationship equation for the sampled fish was $W=0.009L$, indicating that the species has a healthy growth pattern in its natural environment. The analysis of the stomach contents revealed that 37% of the stomachs were full, while 8%, 13%, 14% and 28% were three fourths full, half full, one fourth full and empty respectively. By the analysis of the stomachs, which contained food by the frequency of occurrence method, it was seen that 60% of the stomachs contained fish (herrings, anchovies, *Sardinella* sp. and ribbon fish), 16% shrimp, 5% cephalopods, 11% fish and shrimp, 7% fish and cephalopods and 1% shrimp and cephalopods (by weight). In addition, a few stomachs contained stomatopod larvae, plastics debris and plant leaves. This shows that Kawakawa are non-selective feeders. The Gonado-Somatic Index (GSI) gave 2 peaks, which shows that spawning is prolonged from May to October. The fecundity ranged from 203,000 to 1,723,000. DNA Barcoding for nine samples confirmed the species present in the Indian Ocean as being *Euthynnusaffinis* with 99.8% similarity.

Keywords: *Euthynnus affinis*, barcoding, feeding, spawning.

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420/D

Diagnostic accuracy of in-house developed indirect enzyme-linked immunosorbent assays for HPV16 and HPV18 high-risk human papillomaviral infections in oral and oropharyngeal cancer patients in Sri Lanka

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Human papillomaviral (HPV) infection is recognised as a relatively novel major risk factor for oral and oropharyngeal cancers (OOPC). High-risk HPV types (HPV16 and HPV18) are known to be responsible for two thirds of all invasive OOPCs. HPV seropositivity reflects past or present HPV exposure and is associated with risk for OOPC. This case control study aimed to assay for HPV specific IgG antibodies for HPV16 and HPV18, in test and control serum samples, using in-house developed indirect ELISAs and to standardize these tests with diagnostic accuracy. The association of high-risk HPV in OOPC was assayed using the levels of anti-HPV IgG antibodies present in 100 OOPC patients and 100 age and gender matched non-cancer healthy control subjects. HPV 16 and HPV 18 virus like particles (VLPs) were used as antigen. Serologic response to both HPV16 and HPV18 infection showed a statistically significant difference between test and control groups ($P < 0.05$). Anti HPV16 IgG antibodies were detected in 24% of OOPC patients as well as in 3% of non-cancer controls, while 19% of OOPC patients and 2% of controls harboured anti HPV 18 IgG antibodies. The test group was more likely to have had exposure to HPV 16/18 infections, with a 4 fold increased risk for developing OOPC (HPV 16: OR=4.3, 95%CI=1.225-17.446 and HPV 18: OR=4.0, 95%CI=1.114-17.341) compared with controls. Receiver Operating Characteristic (ROC) analyses using MedCalc; version 17.6 software standardized the two ELISAs. The anti HPV16 antibody ELISA showed 96% accuracy (sensitivity = 93%, specificity =94.4%, cut off ≥ 0.134) while the anti HPV18 antibody ELISA resulted in 91% accuracy (sensitivity = 87.2%, specificity =84%, cut off ≥ 0.097) in discriminating the test group from controls. Thus, these in-house developed ELISAs provide serologic diagnostic tools with high accuracy for the detection of high-risk HPV16 and HPV18 in OOPC.

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Section E1

501/E1

The spectral response broadening in dye sensitized devices due to the length of polymethine chain and the other ligands in cyanine dyes

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In dye sensitized (DS) devices, the excited dye molecules inject carriers to the energy bands of the attached semiconductor material, thereby separating the charges and driving a current in an external circuit. Although many initially encountered technical hurdles are overcome, the efficiency of DS solar cells remains low due to the narrower spectral response. Therefore, investigation of methods to broaden the spectral response of a DS solar cell is very important. In general, long carbonic chains are known to absorb infrared radiation. Alterations of a cyanine dye molecules with carbon chains can be used to extend the response spectra of the DS solar cell and other DS devices. The results of such an investigation are presented here. The investigation was carried out with four cyanine dye derivatives. These dyes were coated on TiO₂ electrodes. The TiO₂ electrodes were prepared by hydrolysis of titanium isopropoxide and depositing the slurry on fluorine doped conducting tin oxide (FTO) glass plates (1× 1.5 cm²). CuSCN dissolved in propyl sulfide was used as the hole collecting (p-type) material, and was deposited on the dye coating, by keeping the dye coated electrode on a hot plate (~120 °C). The result shows broadening in the absorption and response spectra of the DS device as the length of the carbon chains in the dye molecules increases. The cyanine dye with the longest central polymethine chain, has the largest red shift in the response spectra threshold, which extended into the near infrared region (~900nm). Additionally, the lengths of the other carbon ligands in the dye molecules also contributed to the broadening of the spectral response of DS devices. For the other three dyes, consisting of the same center polymethine chain length but with the CH₃-, the CH₃CH₂- and the (CH₃)₂N(CH₂)₃- ligands attached to pyrrolidinium ring had their response thresholds red shifted in the same consecutive order as the ligand length, implying a correlation among the chain length and the extension in the response threshold.

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502/E1

Identification of the shape of a drumhead by the sound it produces

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Drums are the world's oldest and most widespread of musical instruments. At the beginning Mathematicians started to investigate questions such as, if two drums sound exactly the same, where they have identical fundamental frequencies as well as harmonics, then what geometric features do they have in common? Followed by this, the Polish Mathematician Mark Kac in 1966 first posed the question, 'Can one hear the shape of a drum?' which remained unanswered for about quarter century until Gordon, Webb and Wopert (1992) gave an example of two differently shaped drums that sounded exactly the same (*i.e.*, having identical frequency spectra) answering negative to Kac's question. Nevertheless if basic shapes (like rectangular and circular), are considered to be the drum membrane, ignoring the air column below, whether it is possible to distinguish them by observing their frequency and amplitude spectra addressed by solving the wave equation in this research. The wave equation in two dimensions was solved in rectangular Cartesian coordinates and cylindrical polar coordinates using the method of separation of variables. The frequency spectrum for both cases were determined through numerical implementation of discrete Fourier transforms using MATLAB software. Results of the study show that a circular drumhead and a rectangular drumhead have distinct frequency spectra when both of them are subjected to initial symmetrical disturbances and hence it is possible to distinguish them from the sound they produce. Nowadays the most widely used drumhead is the round shape and rectangular drumheads are rarely used. The reason behind this is the monotonous hollow sound produced by the latter and the good sound and melody produced by the former. The key aspect of conducting this research is to inspect the reasons as to how this happens.

Key Words: Discrete Fourier Transform, Frequency Spectra

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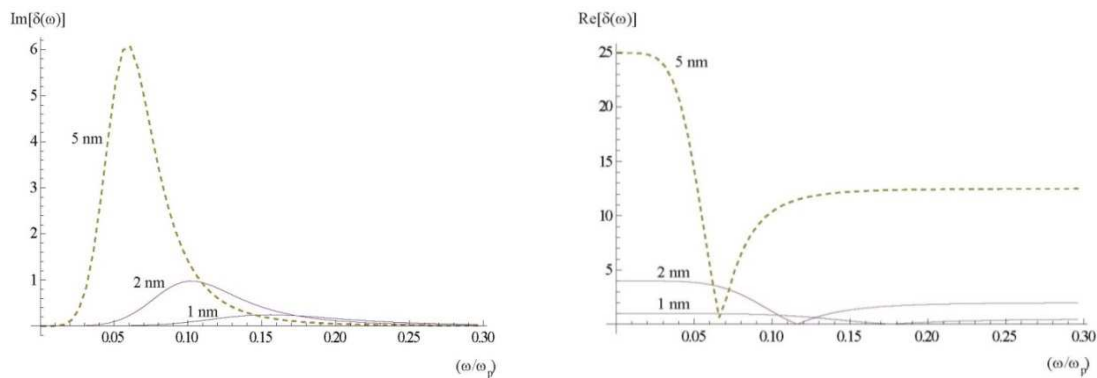
503/E1

Theoretical study of nonlocal effects in nanoplasmonic structures

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We study the importance of taking the nonlocal effects in optical response of metals into account for accurate determination of optical properties of nanoplasmonic structures. When considering bulk materials, to explain the optical properties, it is sufficient to take only the temporal dispersion into account. But considering nanoscale structures, it is not just enough to take temporal dispersion into account, but need to consider both temporal and spatial dispersion to explain optical properties. Here we focus on calculating the transverse static polarizability of a spherical nano particle and cylindrical nanowire by taking both temporal and spatial dispersion into account. To describe these phenomena, we have developed an analytical theory by solving the well-known Lindhard formula which gives one of the closed solutions in the theory of Fermi systems that explicitly gives the nonlocal dielectric response function (longitudinal) $\varepsilon(k, \omega)$. The theory is applied to calculate the polarizability of dielectric and metallic nanospheres and cylindrical nanowires. The two figures show the variation of imaginary and real parts of the polarizability of a nanosphere including nonlocal effects. The figures clearly show that the absorption peaks move to the low energy region as the radii increases. Furthermore, there is a critical frequency which gives a small or zero real part for the polarizability for a nanosphere. The most significant result is that such a behavior cannot be explained using the usual local response. A simple theoretical framework for the polarizability of a nanosphere has been developed, and a nanowire that allows the inclusion of nonlocaleffects. Results are significant for thin wires and small particles, where the nonlocal effects are much more relevant. We hope that our work will be useful in studying the optical properties of nanowires and nanospheres.



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504/E1

A new cosmological model including inflation, deceleration, acceleration and deceleration again

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Since Perlmutter and A.G. Riess (1997 & 1998) observed that the Universe expands with an acceleration, many models involving dark energy have been proposed to explain this phenomenon. In this research we present a family of cosmological models with both acceleration and deceleration. We write Einstein's Field Equations in General Relativity in the form,

$$R^{\mu\nu} - \frac{1}{2}\bar{R}g^{\mu\nu} = kT^{\mu\nu} - \Lambda g^{\mu\nu}$$

Here Λ is the cosmological constant. In this research we modified Einstein's Field Equations. We consider Λ to be a variable of cosmic time. We made the assumptions of a homogeneous and isotropic universe based on Mach's principle. We started with the Robertson-Walker metric in spherical polar coordinates. We found the Christoffel symbols to define the Ricci tensor, the curvature scalar and the energy-momentum tensor using the Robertson-Walker metric. Using the Robertson-Walker metric and Energy momentum tensor we solved the modified Einstein's Field Equations for scalar factor $R(t)$ which is called "radius of the universe." We introduce the solution in the form $R = b\sqrt{(1 - \cos^3 \omega t)}$, so that it shows the inflation at the beginning. We assume a solution for the universe, which results in inflation, deceleration, acceleration and deceleration again. The age of the universe is estimated to be 13.7 billion years. Taking the present value of the cosmic time t as 13.7 billion years we find the density of the inflationary Universe is $2.0211 \times 10^{-31} \text{g cm}^{-3}$ and deceleration of the Universe is $9.1822 \times 10^5 \text{cm s}^{-2}$ which agree with the observations. We discussed the redshift of light from extragalactic sources, which arise from the Robertson-Walker metric. The redshift is the ratio of the value of the scalar factor of the universe at present epoch to that at the epoch of emission of light from the extragalactic sources, which is observed at present and is a measure of the expansion of the universe in a given period of time. The scalar factor is increasing with time t at present. However there could be epochs where the scalar factor is decreasing.

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505/E1

Wettability determined by angle of contact measurements for electrodeposited Cu₂O thin films with sulphur based surface treatments or chlorine doping

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The angle of contact (α) was measured for Cu₂O thin films electrodeposited on Ti substrates with either chlorine doping, or with its surface modified using sulphidation followed by surface passivation. The fabrication of *n*-Cu₂O films were done in an acetate bath containing aqueous solutions of 0.1 M sodium acetate and 0.01 M cupric acetate at 60°C. Sulphidation of *n*-Cu₂O films was achieved by applying a thin layer of an aqueous solution of 0.01 M Na₂S on the surface of the film and allowing to react with the film at 200°C. Subsequently, exposure of the sulphided film surface to (NH₄)₂S passivated the film surface. Chlorine doping was done on *p*-Cu₂O films fabricated using electrodeposition. The amount of chlorine doping was varied in *p*-Cu₂O films deposited in a lactate bath containing an aqueous solution of lactic acid (3 M), cupric sulphate (0.45 M) and sodium hydroxide by varying CuCl₂ concentrations. Using a custom built experimental setup supplemented by image processing software, α measurements of distilled water on the deposited thin films were made using the sessile drop method. Film morphology was revealed by scanning electron micrographs (SEM), while x-ray diffraction (XRD) spectroscopy was used to probe the structural properties of the films. For distilled water, bare Cu₂O films independent of its conductivity type was found to be non-wetting ($\alpha \geq 90^\circ$), exhibiting non-polar surface properties of the film. Sulphidation using Na₂S made the surface of the *n*-Cu₂O films highly wetting ($\alpha < 30^\circ$) as result of the polar nature and the decreased roughness of the sulphided film surface. With subsequent passivation of these sulphided films, the resulting less polar film surface with re-emerged roughness made the films partially wetting ($90^\circ > \alpha \geq 30^\circ$). With increased chlorine doping it was found that α measurements increased making the film surfaces more non-wetting for distilled water. It was also noted that when the morphological structures of the films were in the nano-scale the surfaces were more non-wetting in nature. These observations show that surface modifications and doping not only influence the charge transport properties of Cu₂O thin films, but also affects the wettability which is an important consideration in the context of utilizing them as sensors for detecting molecules having varying charge polarization ability.

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506/E1

Comparison of interface properties of post-treated p-Cu₂O/Au Schottky junctions

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Cu₂O is one of the eco-friendly affordable semiconductor materials that can be used in wide range of semiconductor junction devices such as solar cells, gas sensors, and microwave and optoelectronic devices. Semiconductor surface reconstruction and modification changes the surface properties, which can be used to optimize the overall junction performance. In this study, we studied interface properties of p-Cu₂O thin films in contact with gold, where Cu₂O films were deposited in aqueous acetate electrolyte bath and the surface of the films were subsequently modified by annealing and/or surface passivation. p-Cu₂O thin films were potentiostatically electrodeposited in a 0.1 M sodium acetate and 0.001M cupric acetate aqueous electrolytic solution, with the pH value at 7.2 in p-Cu₂O film deposition bath, at previously determined growth conditions. In order to study the effect of annealing and surface passivation of p-Cu₂O thin films, one set of as-grown p-Cu₂O thin films was annealed at 175°C for 10 minutes, while another identical set of as-grown p-Cu₂O thin films was exposed to 20 vol% of Ammonium Sulfide solution for 8 s at 27°C. The ammonium surface treatment was carried out for some of the above post annealed p-Cu₂O thin films. Au was sputtered on the p-Cu₂O thin films to fabricate Schottky junctions: as-grown p-Cu₂O/Au, annealed p-Cu₂O/Au, surface passivated p-Cu₂O/Au and annealed+surface passivated p-Cu₂O/Au. Mott-Schottky analysis was employed for the investigation of interface properties of Schottky junctions. Results revealed that the post-treated p-Cu₂O thin films in contact with Au modify the interface properties. This result is established by the values obtained from the built-in potential, doping density, minority carrier concentration, electron affinity and work function of the Cu₂O films. Further, the built-in potential relative to the Fermi level of Au has diminished for the surface treated p-Cu₂O thin films compared to the as-grown p-Cu₂O thin films. This result is an evident for the lowering of the relative band edge position of Cu₂O due to the surface reconstruction and/or modification of the interface surface layer. The reported result will be very useful in fabrication of highly efficient Cu₂O based junction devices.

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507/E1

Characterizing musical sounds with the aid of linear algebra through MATLAB

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This study mainly gathers a way of understanding sound (music/ noise) using concepts of linear algebra. This is interesting, because music is an art while mathematics is a science. Moreover, there is lack of findings on defining musical notes in a mathematical way and relationships between music and mathematics are limited. With the aid of a simple MATLAB programme, we analysed any sound. Especially sounds from Dual-Tone Multi Frequency (DTMF) system on telephones and different musical instruments were analysed. The previously recorded sounds were used under this study. Fourier analysis played a major role here. The MATLAB programme converts a signal from its original time domain (wave propagation) to a representation in the frequency domain. Computed Fourier transform of a sound helps to determine the component frequencies and then the musical notes (which is an artistic concept). At the same time through the frequency domain, sound can be written as a sum of simpler trigonometric functions. As an immediate result this enables us to view a sound as elements of a linear space generated by an orthonormal basis. The reason to analyse the sound waves in terms of sinusoidal plane waves lies in the differential equation for simple harmonic motion. Two musical notes are said to be consonant when the ratio of their frequencies is a ratio of two small integers. Further, reasons for the sound difference when the same note is generated by two different musical instruments were analysed. Musical instruments do not vibrate at a single frequency. A given note involves vibrations at many different frequencies often called harmonics. The relative pitch and loudness of these harmonics give the note a characteristic sound. The relative strength of the different frequencies is the difference between two sounds.

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508/E1

An Investigation of properties of prime graph of non-commutative rings

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Let $PG(R)$ be the prime graph of the ring R in which, the vertices are the elements of the ring R and edges represent the set, $E = \{\overline{xy} | xy = 0 \text{ or } yx = 0, x \neq y \text{ and } x, y \in R\}$ while $\Gamma(R)$ denotes the zero divisor graph with the set of nonzero zero-divisors of R , and for distinct $x, y \in Z(R)^*$, the vertices are adjacent if and only if $xy = 0$. In this work, we investigate some properties of the zero divisor graphs and prime graphs. Also, we find the chromatic number, the minimum number of colors that can be used to color the vertices of a graph such that no two adjacent vertices are assigned the same color, of the prime graph of some non-commutative rings.

Keywords: Prime graph, prime ring, zero divisor graph, chromatic number

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509/E1

Establishing a criterion to develop non-destructive testing methods for adhesively bonded textile structures using Fourier transforms

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Currently, there is a growing trend in the apparel industry to replace traditional stitching by pasting using heated adhesives. However, the quality of such apparel depends upon the bond strength of the adhesive to the fabric material. The bond strength of the seams is generally tested adopting destructive methods such as peel strength test, which results in wastage. The primary objective of this study is to formulate a non-destructive testing methodology that is compatible at the assembly line level involving the measurement of a certain parameter that can be correlated with the peel strength. Once the correlation is established this parameter can replace the need for destructive peel strength testing. It has been hypothesized that the strength of the bond depends on the surface temperature distribution at the time of thermosetting of the adhesive polymer. We use infrared thermography and Fourier transform techniques to determine the distribution of the temperature of the bonded segments. The peel strength of the bonded samples was measured according to the standard procedures recommended in the industry. A parameter is then defined based on the correlation between spatial homogeneity of the temperature distribution and peel strength values, and the minimum value of the parameter that ensures required peel strength was determined. Further tests carried with samples showed that this minimum value of the parameter is a reliable indicator of the expected peel strength of a bonded sample.

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510/E1

Confirmation of earth's closed loop orbit using tidal waves

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The word 'tide' is a prevalent term used to define the alternating rise and fall in the sea level with respect to the land, produced by the gravitational attraction of the moon and the sun. To a better understanding of the tide, it is necessary to study each astronomical motion, together with its associated tide producing forces, separately. The present study was carried out with an attempt to confirm the Earth's closed loop orbit using tidal height changes due to the motion of the Sun, Moon and Earth in the Trincomalee coastal area of Sri Lanka. Tidal heights from the Mean Sea Level (MSL) were measured every fifteen minutes throughout the year 2015 (365 days) using the tide pole installed in the sea in the Trincomalee coastal area, which was built by the Hydrography Survey Unit of Sri Lanka Navy. Using the data obtained, the behavior of tidal waves was identified. The main tidal constituents were obtained using Tidal Analysis Tool (TAT). The tidal constituent 'Principal solar semidiurnal constituent' (S_2), which is the consideration of the tidal effect caused by the sun, was then chosen from TAT application because the Earth's orbit around the Sun is caused only by the forces between the Earth and the Sun. Fast Fourier Transformation (FFT) and Interpolation methods were used to analyze the chosen tidal constituent, S_2 , together with the obtained tidal data to confirm the Earth's closed loop orbit around the Sun. Meteorological factors and human errors can occur while collecting data and hence there are eighteen peaks towards the inside of the loop. The following elliptic-shaped orbit was obtained at the confidence level of 50% after removing such data.

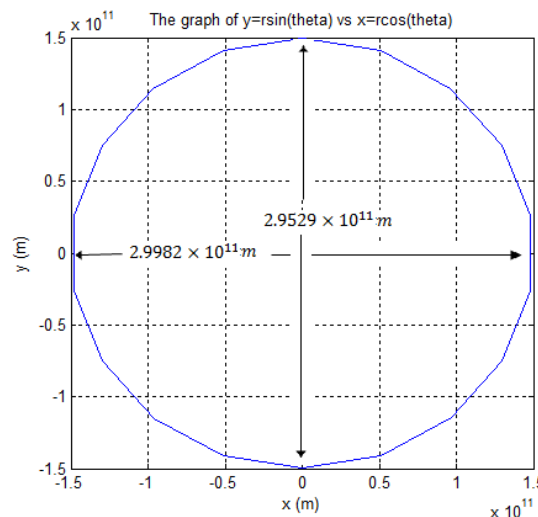


Figure 1: Earth's closed loop orbit



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Fermi-LAT GeV Flux Observation of the BL Lacertae Object

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The BL Lacertae object (also known as 1ES 2200+420, TeV J2202+422 and 3FGL J2202.7+4217) is a Blazar type Active Galactic Nucleus (AGNs). Blazars are powerful, Very High Energy (VHE) Gamma-Ray point-light sources. They have relativistic jets pointing along the line of sight of the Earth, and have a highly variable flux from radio to TeV energies. The variability timescale of the flux is an important measurement to identify the location and the size of the emission zone. This paper describes the GeV (1 GeV – 100 GeV) Gamma-Ray flux variability of the BL Lacertae object between 2011 and 2016. The data has been obtained using the Fermi-Large Area Telescope (Fermi-LAT), which is the paramount scientific instrument on the Fermi Gamma-Ray Space Telescope Spacecraft. The daily binned GeV light curve has been obtained using the Fermi-LAT Science Tool and ROOT software. This work discovered one micro flare on 20th June 2015. The maximum and lowest VHE Gamma-Ray daily binned fluxes detected from BL Lacertae are $(1.21\text{E-}07 \pm 3.66\text{E-}08)$ photon $\text{cm}^{-2} \text{s}^{-1}$ and $(9.78\text{E-}09 \pm 9.66\text{E-}09)$ photon $\text{cm}^{-2} \text{s}^{-1}$ respectively. The Mean Fractional Variation (MFV) has been calculated and the obtained value of the MFV is 0.48. This MFV value indicates that the BL Lacertae object has a GeV Gamma-Ray flux that is variable in the daily scale (daily binned).

Key words: Active Galactic Nuclei, Blazars, flux, light curve, variability

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512/E1

Finite difference Weerakoon-Fernando method to solve nonlinear equations without using derivatives

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This research was mainly conducted to explore the possibility of formulating an efficient algorithm to find roots of nonlinear equations without using the derivative of the function. The Weerakoon-Fernando method had been taken as the base in this project to find a new method without the derivative. After several unsuccessful attempts we were fortunate to be able to formulate the Finite Difference Weerakoon-Fernando Method (FDWFM) presented here. We noticed that the FDWFM approaches the root faster than popular nonlinear equation solvers such as Secant method in the absence of the derivative. By implementing FDWFM on non-linear equations with complex roots and also on systems of non-linear equations, we received very encouraging results. When applying the FDWFM to systems of non-linear equations, we resolved the involvement of the Jacobian problem by following the procedure in the Broyden's method. The computational order of convergence of the FDWFM was close to 2.5 for all these cases.

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Section E2

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Hepatoprotective activity of *Atalantia ceylanica* against ethanol induced hepatotoxicity on HepG2 human liver cells

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Chronic ethanol consumption is a serious medical problem, as it has become a common beverage in social gatherings worldwide. Over consumption of ethanol increases adverse health effects such as chronic liver diseases. Herbal medicine has been used in the treatment of chronic liver diseases. An aqueous extract of *Atalantia ceylanica* (Yakinaran) was prepared from tender leaves according to the procedure followed by Ayurvedic practitioners in Sri Lanka, and analyzed for phytochemical constituents, antioxidant and hepatoprotective activities *in vitro*. Total phenolic content (TPC) and total flavonoid content (TFC) were determined by the Folin-Ciocalteu method and Aluminium Chloride colorimetric assay, respectively. Hydroxyl radical and 1,1-Diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging activities were determined to evaluate antioxidant activities of plant extract. The cytotoxic range of ethanol and *A. ceylanica* was evaluated to determine optimum concentrations needed for evaluation of hepatoprotective activity using hepatocellular carcinoma (HepG2) cells. Cell damage was induced by ethanol (3%). *A. ceylanica* was co-exposed with ethanol to investigate the hepatoprotective activity against ethanol induced cytotoxicity. The 3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide (MTT) assay was used to evaluate the cell viability for all experiments. The extraction yield of *A. ceylanica* was 10.8±0.9 %. TPC and TFC were 4.1±0.4 gallic acid equivalent w/w% and 7.8±0.9 (-)-epigallocatechin gallate equivalent w/w%, respectively. The EC₅₀ values for DPPH and Hydroxyl radical scavenging activity were 311.9±37.5 and 48.4±4.1 µg/mL. No toxicity was found on cells treated with plant extract alone (EC₅₀> 3500 µg/mL). The cell viability was 40.0% relative to the untreated cells for ethanol induced toxicity and it significantly increased (p<0.05) with co-exposure of the plant extract at concentrations between 15-45 µg/mL. The highest increase was observed at 15 µg/mL concentration of the plant extract with a percentage cell viability of 67.2%. *A. ceylanica* aqueous extract has the capability to act as an effective hepatoprotective agent against ethanol induced cell damage under *in-vitro* conditions.

Keywords: Hepatoprotective, *Atalantia ceylanica*, ethanol, HepG2

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Analysis of proximate composition and physicochemical properties of pineapple wastes

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Pineapple is one of the fruits widely grown in Sri Lanka. Mauritius is the main pineapple variety cultivated in Sri Lanka for local consumption and processing, however during processing around 40 – 60% of the total fruit is disposed of as waste. This study was undertaken to quantify the proximate composition and some physicochemical parameters of three types of wastes generated during pineapple processing, namely; 1st peel, 2nd peel, and core of the Mauritius variety, to identify the potential to utilize them. The selected wastes were analyzed for proximate composition (moisture, crude protein, crude fat, crude fibre, total ash, minerals and carbohydrate) on a dry basis (AOAC methods), and pH, Titratable Acidity (TA), Total Soluble Solids (TSS), pectin content, and total polyphenols were also determined. The highest moisture was found in the 2nd peel (87.37 ± 0.34 %) and was significantly different ($P < 0.05$) from the moisture content of core (84.90 ± 0.23 %). The crude protein content was highest in the 1st peel (5.04 ± 0.05 g/100 g) and was significantly different ($P < 0.05$) from the 2nd peel and core. Highest crude fat content was recorded in the 2nd peel (4.78 ± 0.53 %), and lowest in the core (2.35 ± 0.15 %). The crude fiber content of the 1st peel was the highest (42.02 ± 1.72 %) and was significantly different from the 2nd peel and the core. The carbohydrate content of core (83.03 ± 0.32 %) was the highest. There was a significant difference ($P < 0.05$) between the ash content of the 1st peel, 2nd peel and the core. Potassium was the most abundant mineral in all 3 waste types, followed by Ca, Mn and Fe. All the three wastes had an acidic pH, which was lowest in the 2nd peel (3.85 ± 0.01). TSS was highest in the 2nd peel. The highest pectin content (0.30%) and total poly phenols (341.4 ± 1.4 ppm of Gallic Acid Equivalents) were recorded in the 1st peel. Results shown that, pineapple wastes can be utilized effectively for alcoholic fermentation, polyphenol extraction and food product development based on the evaluated physicochemical properties.

Key words: pineapple, 1st peel, 2nd peel, core, physicochemical properties.

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Effect of *Psidium guineense* Sw. leaf (PGL) extract and coconut cake (CC) extract on serum lipid profiles and serum antioxidant capacity of Wistar rats

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Psidium guineense Sw. leaf (PGL) and coconut cake (CC) are considered as potential sources of natural antioxidants with antioxidant activities comparable to that of many synthetic antioxidants. However, to the best of our knowledge, the antioxidant activities have not been reported in animal models. The effects of orally feeding PGL and CC extracts on serum lipid profiles and antioxidant capacity in Wistar rats were determined in the present study. Seven weeks old male Wistar rats (weight 240-300 g) were randomly assigned into treatment groups (n=7) after being acclimatized to basal diet for a week. Phenolic antioxidants from PGL and CC were extracted into an ethanol:water (70:30) solvent system. The solvent was then removed and residue was dissolved in distilled water. The control group was orally fed with distilled water (1 mL). The second and third groups were orally fed with PGL extract (1 mL) and CC extract (1 mL) at 400 mg/kg of body weight. All groups received a semisynthetic diet recommended by the WHO. Blood was drawn from the tail vein of rats on the day before initiating oral administration of antioxidant extracts and after 30, 90, 120 and 150 days of oral administration of antioxidant extracts. Serum total cholesterol (TC), high density lipoprotein (HDL) cholesterol and triglycerides (TG) were analyzed using G Cell test kit. Low density lipoprotein (LDL) cholesterol was determined using the Friedewald equation. Antioxidant activity of serum was determined by ABTS free radical assay and DPPH radical scavenging assay. Although TC levels decreased in both treatment groups while the HDL levels increased in both treatment groups without any effect in the LDL levels compared to the control group, there were no significant ($p < 0.05$) differences observed in serum TC, HDL and LDL levels among the groups during the study period. Serum TG levels, on the other hand, significantly ($p < 0.05$) decreased compared to the control group after 30 days. Oral administration of antioxidant extracts for a period longer than 90 days caused a significant ($p < 0.05$) improvement of Trolox equivalent antioxidant capacity compared to control group. The effect was more pronounced for PGL than CC extract. Groups fed with antioxidant extracts showed significantly ($p < 0.05$) increased DPPH radical scavenging activities compared to that of the control group as well as their baseline values. PGL and CC extracts exerted beneficial effects on both serum lipid profiles and antioxidant activity in Wistar rats, which may retard the oxidative damage to biomolecules.

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Antioxidant properties of fenugreek (*Trigonella foenum-graecum*) seed extracts used in Sri Lankan ethnomedicine

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Chronic diseases are rapidly increasing worldwide. Oxidative stress is known to play a crucial role in the progression of chronic diseases. Natural products with antioxidant properties have shown positive effects in the prevention and management of such diseases. Fenugreek is a well known traditional medicinal plant. In Sri Lankan ethnomedicine it is claimed to have variety of health benefits. However, there are no previous reports on antioxidant properties of fenugreek seed extracts used in the Sri Lankan ethnomedicine. The present study investigated a range of antioxidant properties of fenugreek seed extracts used in Sri Lankan ethnomedicine. The freeze-dried water extract of germinated fenugreek seeds (WEGFS), water extract of seed flour (WESF), and hot water seed extract (HWSE) were used in this study. These extracts were evaluated for total polyphenolic content (TPC), total flavonoid content (TFC), ferric reducing antioxidant power (FRAP) and 1,1-diphenyl-2-picrylhydrazine (DPPH), 2,2'-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) di-ammonium salt (ABTS) and superoxide scavenging (SS) antioxidant properties (n=3 each) *in vitro*. Significant differences (P<0.05) were observed among the fenugreek seed extracts for the investigated antioxidant properties. WEGFS exhibited the highest TPC (114.0 ± 2.9 mg gallic acid equivalents/g), TFC (38.54±0.57 mg quercetin equivalents/g), FRAP (75.7 ±6.4 mg Trolox equivalents (TE)/g), DPPH (59.85±0.66 mg TE/g), and ABTS (111.1 ± 12.0mg TE/g) antioxidant properties, while for SS activity WESF (317.43±0.58mg quercetin equivalents/g) had the highest activity. The order of potency of fenugreek seed extracts for TPC, TFC, FRAP, DPPH and ABTS was WEGFS>HWSE>WESF, while for SS it was observed as WESF>WEGFS>HWSE. It is concluded that WEGFS had the highest antioxidant properties (except for SS). This study scientifically validated some of the health claims of fenugreek seed extracts used in the Sri Lankan ethnomedicine.

Keywords: Antioxidant properties, fenugreek extracts, Sri Lankan ethnomedicine.

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**Study on physico-chemical properties and fatty acid profile of Sri Lankan groundnuts
(*Arachis hypogaea* L.)**

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Groundnut (*Arachis hypogaea* L.) is an oil seed belongs to legume crops, which is mostly used in snacks and confectionary industry. The demand for the groundnuts highly depends on its quality attributes, nutritional composition and the stability of oil, which determine the keeping quality of groundnuts. Hence, the objective of this study was to determine the physio-chemical properties and fatty acid profiles of groundnuts grown in Sri Lanka with an intension of selecting the best variety or the accession for large scale production. Physical attributes (Pod length, seeds per pod, seed size, shape, seed testa color and weight of 100 seeds), proximate composition and fatty acid profiles were carried out for 6 groundnut varieties and 6 promising accessions developed at Angunakolapelessa (GLORDC). The proximate composition was determined in accordance to A.O.A.C official methods specified in 2012 for nuts. The fatty acid profile of each variety and the lines were determined by a gas chromatographic technique according to SLS 313 part 4/section 1:2010, which is adopted from the ISO method specified in 2000 (ISO 5509:2000-E). The moisture content of samples significantly varied from 5.04% to 7.79% ($p < 0.05$). The ash content, crude protein and crude fat content were 2.43% - 3.20 %, 24.09% -33.27%, and 42.47% - 50.81%, respectively, on dry basis, and showed a significant difference among all varieties and accessions ($p < 0.05$). The crude fiber content varied from 2.33% to 3.97% on dry basis and no significant difference ($p = 0.205$) was observed among them. The total carbohydrate content varied from 17.14% to 21.53%. Oleic (C18:1), Linoleic (C 18:2), Palmitic (C 16:0), Stearic (C 18:0), Arachidic (C 20:0), Gadoleic (C 20:1), Behenic (C 22:0) and Lignoceric (C 24:0) are the major fatty acids identified, and the composition was 38.14 %- 59.22 %, 23.97% -39.48%, 14.72% -8.99%, 2.26%- 4.36%, 1.07% - 1.80%, 0.73% -1.09%, 0.88% -2.86%, and 0.49%- 1.49%, respectively, with significant differences ($p < 0.05$) among all. The ratio of oleic to linoleic acid predicts the stability of oil, and this was in the range 0.97%-2.41% and showed an inverse relationship between them (correlation coefficient $R^2 = -0.988$). SFA, MUFA, PUFA and USFA vary within the range of 15.24% - 21.56%, 38.93%-60.18%, 24.59%-39.48%, and 84.76% -78.14% respectively. According to the physical attributes and fatty acid profile, the most suitable variety for the confectionary industry and as a snack is Walawa, and promising lines for further breeding are 98396 × Red Spanish, 98396 ×10663, ICGV 05200, and ICGV 05198.

Keywords: Groundnut, varieties, accessions, Proximate composition, fatty acid profile.

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606/E2

Encapsulation of β -carotene fortified virgin coconut oil to form soft gel capsules

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Production of soft gel capsules using a non-gelatin shell material is a new trend as the animal source of gelatin can be a problem for certain consumers. In this study, encapsulation of β -carotene fortified virgin coconut oil to form soft gel capsules was studied by using calcium alginate as the shell material as it is versatile and accommodates a wide variety of compounds. β -Carotene was extracted into virgin coconut oil from carrots. Soft gel capsules were prepared according to the selected formulation with 4% alginate solution and 75 mg of CaCl_2 content in the virgin coconut oil emulsion. As physical parameters, the average diameter of soft gel capsules was 8.132 ± 0.349 mm, and the average weight was 0.469 ± 0.058 g with a weight loss of 23.5% during drying due to moisture and alginate loss. The capsule coating thickness was 0.340 ± 0.049 mm and coating weight was 0.123 ± 0.018 g. Hardness and hardness work determined by the texture analyser were 321.5 ± 22.5 g and 6.190 ± 0.794 mJ, respectively. Encapsulation Efficiency (EE) and Loading Capacity (LC) of β carotene fortified virgin coconut oil were calculated to study the amount of core material entrapped within the shell. EE was $68.237 \pm 0.031\%$ while LC was $75.83 \pm 1.81\%$. As chemical parameters, β -carotene content was quantified by High Performance Liquid Chromatography (HPLC) and UV-visible spectroscopic methods to determine the amount of β -Carotene in soft gel capsules, and they were 15.20 ppm and 18.96 ± 0.85 ppm respectively. The ash content of capsules was $1.34 \pm 0.05\%$ which has a contribution of $66.46 \pm 2.72\%$ of Calcium. The moisture content was increased from $7.42 \pm 0.34\%$ to $9.63 \pm 0.51\%$ within a month due to the hygroscopic nature of the glycerol in outer layer of capsules, as glycerol was added as a plasticizer. It can be concluded that soft gel capsules with β -carotene fortified virgin coconut oil can be prepared according to the selected formulation under properly and carefully maintained processing conditions since the gelling process of calcium alginate takes place under mild conditions.

Key words: Encapsulation, Calcium alginate, Soft gel capsules, β Carotene

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607/E2

Synthesis of cellulose sulfate by enhancing cellulose swelling using microwave energy

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Cellulose sulfate (CS) has many industrial applications. In traditional CS synthesis, swelling of cellulose was performed using a large amount of solvents and conventional heating for 10 to 12 hours. The objective of this study was to develop a method for synthesis of CS using chlorosulfonic acid (CSA) as the sulfation agent while enhancing cellulose swelling using microwave energy. The developed CS synthesis method can be divided into four stages; swelling, sulfation, neutralization and purification. Swelling was accomplished within 1 minute at 300 W microwave power while minimizing the solvent usage. Pyridine:formamide (1:1.2 v/v) was identified as the best solvent system for the swelling of cellulose. Use of microwave irradiation on sulfation is not advisable due to formation of char. CSA was added into the reaction mixture in an ice bath and kept 12 – 15 hours at 4°C. Neutralization was done using NaOH and the optimum concentration was identified as 1 mol dm⁻³. Cooling the reaction mixture while neutralizing enhanced the final yield up to 43%. Instead of the dialysis, crude CS was dissolved in distilled water (15.0 mL), and centrifuged to remove unreacted cellulose. Warming of the solution while dissolving crude CS further enhanced the yield. Finally the CS in the supernatant was precipitated by adding two volumes of ethanol. The maximum yield of 46% was achieved under optimized conditions (swelling at 300 W for 1 minute, 1 mol dm⁻³ NaOH for neutralization, optimum cooling and warming at -12 °C and 60 °C, respectively) whereas the yield was 34% when the conventional swelling was performed. Products were characterized using ATR-FTIR spectroscopy and the S=O stretching peaks were observed between 1225-1235 cm⁻¹. The ¹H NMR spectrum of CS shows the anomeric protons at 5.75 ppm and all other protons between 3.5 – 5.5 ppm. The mass spectrum (Electrospray ionization) gave a major peak at m/z 851, which corresponds to the sulfated glucose dimer unit with average degree of substitution 2.5. The resultant CS contains five –SO₃Na groups having molecular formula C₁₂H₁₆O₂₆S₅Na₅ (Calculated: 851.51384; experimental: 851.3958). In conclusion, CS was successfully synthesized using a modified method by enhancing the swelling of cellulose using microwave energy. Optimized conditions can be successfully applied to convert agricultural wastes into value-added products in future.

Keywords: Cellulose, Cellulose sulfate, Swelling, Microwave energy, Sulfation.

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608/E2

Computational investigation of the interaction of denaturing and protecting agents on folded and unfolded proteins

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Proteins are the most abundant biological macro molecules that show great diversity of functions from differentiation of cells to crucial enzymatic reactions. The unique three dimensional structure of proteins lead to specific biochemical functions. Oxygen binding protein like hemoglobin, specific enzymes that catalyze thousands of reactions, milk proteins, feathers, and genetic expression are a few functional roles of them. The wide range of functional groups and specific 3D structures of proteins are some key features that lead to this wide range of functions. Unfolding of proteins could change their functionality. A denaturing agent, urea, unfolds proteins, while glycine betaine (GB), a protecting agent, resists the unfolding of proteins. To elucidate binding modes of urea and GB with a protein, molecular dynamics (MD) studies were conducted for the RNA binding domain 2 protein (PDB ID: 2U1A) in aqueous urea and aqueous GB solutions of different concentrations. First, 2U1A was unfolded with MD at high temperature. After that, a series of MD simulations were conducted with native and the unfolded protein separately with different concentrations of urea and GB in aqueous medium using GROMACS software package. The interaction patterns were investigated in terms of preferential interaction parameter (PIP), root mean square deviations (RMSD), radius of gyration (RG), interaction energy and solvent accessible surface area (SASA). PIP values are given in the Table below

	Concentration (mol/dm ³)	PIP of proteins	
		Native	Unfolded
Urea	1.20	-4.20	5.69
Urea	2.30	5.51	9.38
Urea	3.60	5.53	14.76
Urea	8.00	-0.33	8.02
GB	1.28	-1.03	-1.83
GB	1.93	-2.91	-3.57

Results show enrichment of urea and depletion of water from all the concentrations in unfolded state and moderate concentrations in folded state. The magnitude of affinity of urea is higher for unfolded state. The exclusion behavior of GB from the protein backbone is prominent in this study. It is interesting to note that protein-GB interaction is stronger with unfolded protein

than with folded protein. It is assumed that the folded state needs not to be protected while the unfolded protein may be turning towards the folded state with relatively stronger interaction with GB. The hydrophobic SASA of the unfolded protein in GB solution showed some reduction of SASA with increasing GB concentration. This may be due to the folding up of the protein in GB solution. These observations have been further strengthened by the reduction of Rg of the unfolded protein with increasing GB concentration.

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Usage of *Stychnos potatorum* seeds for reduction of chemical oxygen demand in laundry effluent

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The untreated wastewater discharged from laundry processes (grey water) is now a major pollution source for surface waters. The objective of this study was to assess the reduction of chemical oxygen demand (COD) from laundry effluent using raw *Stychnos potatorum* (SP) seeds (coagulant) and activated carbon prepared from SP seeds (ACSP) (adsorbent). Optimization studies for treatment time and coagulant/adsorbent dose were done for each case to investigate the optimum parameters to achieve the maximum reduction of COD.

Optimization of treatment time was done agitating the effluent (800.0 mL) and SP seed pieces/ ACSP particles (25.0 g). Samples (10.00 mL) were collected from the reactor at 10 min time intervals, while the whole treatment was conducted up to 100 min. A control study was done with all conditions the same as the treatment study, but without using SP seed pieces or ACSP particles. Optimization of coagulant/adsorbent dose was done by agitating the sample (800.0 mL) with different doses of SP seeds/ACSP varying from 5-50 g. The COD in each sample was measured by using the closed reflux method followed by dichromate titration.

In treatment of laundry effluent (initial COD 3230 mg/L), the maximum percentage reduction of COD by SP seeds and ACSP under optimized conditions were 60% and 90% respectively. Optimized treatment time and coagulant/adsorbent dose for SP seeds was 60 mins and 35 g/800 mL and for ACSP 30 mins and 30 g/800 mL. This study revealed that ACSP is a more efficient agent than raw SP seeds, to reduce COD in laundry effluent. This would be due to the increased pore size of ACSP compared to raw SP seeds, which was clearly proven by the SEM images. However, both agents can be utilized as an effective and less expensive coagulant/adsorbents for the reduction of COD in laundry and textile wastewater.

Key words : *Stychnos potatorum*, COD, Activated carbon

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610/E2

Optimization of curcumin method in determination of boron in steelandusage of natural curcumin in the analysis

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Boron containing alloy steels are mainly used in constructional, automotive and many other applications. The presence of even trace amounts of boron greatly affect the properties of steel. The major function of boron is to increase the hardness of steel and also it gives a better machinability compared with boron-free steel.

As traces of boron affect the properties of steel, it is important to determine it accurately and precisely in the manufacture of these alloys. Due to the drawbacks of common advanced techniques such as Atomic Absorption Spectroscopy or Inductively Coupled Plasma-Atomic Emission Spectroscopy, the universally accepted most sensitive and accurate method for determination of boron in steel is the spectrophotometric method using curcumin as an auxillary agent.

This method is very time consuming and laborious. Although curcumin is the most sensitive spectrophotometric reagent for the above analysis, synthetic curcumin is relatively expensive, and degrades readily when exposed to the atmosphere. This study was carried out to improve and optimize the existing spectroscopic method. In it, several steps of the existing method were altered or skipped and then the recovery of boron was compared with the existing method. As the second part of the study, curcumin was extracted from turmeric and the possibility of using natural curcumin in the analysis was determined.

The results implied that natural curcumin can be used as accurately and precisely as synthetic curcumin in the analysis. A boron-steel alloy sample found to be containing 0.26 ± 0.01 percent of boron with synthetic curcumin gave an amount of 0.25 ± 0.00 percent of boron with natural curcumin, indicating no significant difference in the determination. A steel sample found to be containing 0.27 ± 0.01 percent of boron with the filter paper ashing step gave an amount of 0.26 ± 0.01 percent of boron without the filter paper ashing step indicating that the ashing step of the existing method can be skipped. Altering the distillation step of existing procedure significantly changed the recovery of boron indicating that the distillation step cannot be optimized further.

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611/ E2

Computational design and investigation of antioxidant activity of phenolic compounds and their derivatives

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Among various types of antioxidants, phenolic antioxidants form an important class of compounds, which serves to inhibit the oxidation of materials of both commercial and biological importance.

Density functional theory (DFT) calculations (**BP86** level of theory and **6-311++ G (2df, 2p)** basis set) have been performed on some structurally simple phenolic antioxidants first, and then on novel designed, phenolic derivatives. Moreover, the polarity of the solvent medium has been included in calculating bond dissociation energy (BDE) and ionization potentials (IP). Both H-atom transfer (HAT mechanism) and single electron transfer (SET mechanism) pathways have been investigated by calculating the phenolic O–H bond dissociation energy (BDE) and ionization potentials (IP) in three different phases (gas, aqueous and cyclohexane). How the antioxidant activity of phenolic derivatives is perturbed by electron donor and withdrawing substituents present at ortho, meta, and para positions and the dimerized of phenolic derivatives have also been computationally investigated.

The presence of electron donating substituents on the structure at the ortho and para positions of the phenol increased the antioxidant activity significantly. When secondary and tertiary amine groups were introduced to phenolic antioxidants, the BDE and IP values decreased noticeably (IP from 7.04 to 5.23 and 1.97 eV, BDE from 71.01 to 70.62 and 69.00 kcal/mol). In aqueous phase the designed phenolic antioxidants showed better activity owing to Hydrogen bonding. The effect of solvent on IP values was higher than on BDE, showing that the SET mechanism was highly solvent dependent compared to HAT mechanism. These theoretical computational predictions were superimposable with experimental results reported in literature. When designed novel amino derivatives were dimerized and those monomers were linked through conjugated alkyl chains, they demonstrated much better antioxidant properties (lower BDE) than the monomers themselves (68.05 to 65.04 kcal/mol).

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Section E3

701/E3

Message Brokering Framework for the Health Care Service Application Interoperability

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The proper management and delivery of healthcare services is an information demanding effort. The efficacy of health care operations is greatly affected by the level of automation of information management Systems. Automation is defined as the use of control systems and information technologies to minimize the human interference in the production of goods and services. In the past two decades, healthcare institutions and hospitals in particular, have begun to automate aspects of their information management systems. Such efforts have been geared towards reducing paper-based data processing, improving cash flow, and also supporting the decision making process. With the rapid development of information technology in the health care industry, local health care institutes and centers have started to use different kind of health care applications in order to do perform day to day operations and transactions. Often these applications have been developed by different vendors or in house groups, with each product or system having highly specific information formats and built on different kinds of technology platforms, despite the fact that the Ministry of Health has published “National e-Health Guidelines and Standards” documentation, aimed at ensuring that future ICT adaptations in the healthcare sector conform to a set of uniform guidelines and standards.

Today in most private hospitals as well as public hospitals they do have automated health care systems and they record their patients’ medical information in their local databases. But these systems are not interconnected in order to exchange health care information. Health care information of an individual should not be limited only to a particular institute. Integrating the current health care systems is a huge challenge and it seems to be impossible because these systems are built on different technology platforms and use heterogeneous data formats. And also replacing these legacy systems is an expensive task. Therefore, a solution to overcome this problem is needed.

A model framework was developed to remedy interoperability issues and support the exchange of information between systems. A message brokering framework was developed with the help of the HL7 messaging standard. This framework could be installed along with the legacy systems in the local domain in order to transfer health care information in the form of HL7 messages to a centralized data storage or a HL7 server.

The prototype was implemented only to generate ADT (admission, discharge and transfer) messages since it’s the most widely used message type. The implemented framework was tested with the HHIMS which is an automated health care System implemented by ICTA. Interconnecting these legacy systems with the centralized databases through the message brokering framework could provide better health care service to the people since every piece of information of an individual is very important when it comes to the medication point of view.



702/E3

Awareness of Cyber Security Level and its Effects on System Usage Intention among Employees of Higher Education Sector with Special Emphasis to the Institute of Chartered Accountants of Sri Lanka

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When organizations move from ordinary manual work to a computerized digital environment, their sustainability is depending on the precise use of information systems and the employee's system usage intentions. Various researchers have identified different factors that have an effect on an employee's system usage intention; from this study researchers have tried to understand how system usage intention depends on the employee's cyber security awareness. This study first has analyzed how an employee's demographical data has affected breach awareness and preventive technique awareness. Later it has been analyzed how these Intervening variables have affected the employee's system usage intention in The Institute of Chartered Accountants of Sri Lanka. Correlation analysis proved that there is a significant positive relationship between cybersecurity awareness and system usage intention. Furthermore, the result proved that education qualification and gender have a positive relationship with cybersecurity awareness. According to the responses received from the staff, the majority of the staff have a good perception to be secure, but analyzing the responses received from them for the multiple-choice questions, it is clearly proved that they do not have an acceptable level of knowledge about cyber security. According to regression output, when staff breach awareness increased by one level, system usage intention increased by .356 (36%), and when preventive technique awareness increased by one level, their system usage intention is increased by 0.425 (42%). The F calculated at the 5% level of significance was 3.20. According to the ANOVA result, the calculated value of F is 26.908 and it is greater than F critical, hence the overall model was significant. Hence, it can be recommended to the Institute that they should focus on continuing development of employee awareness about the cyber security concept and technique.

Keywords: Cybersecurity, System usage, organizational risk, data security.



703/E3

Analysis of Alcoholic and Non-alcoholic EEG signals

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This paper analyses the effect of Electroencephalogram (EEG) signals correlated with alcoholic and non-alcoholic subjects and the possibilities of detecting the alcohol consumed by people from controls, using EEG signals. EEG records the electrical activity from the brain, and is useful for assessing the current mental status of a person. EEG data from 20 alcoholic and 20 non-alcoholic subjects were used for the analysis. Band power, power spectral density and mean frequency were used as features and Support Vector Machines was used for classifying EEG signals. The classification accuracy for the whole EEG signal is 98.52% and 98.83% for a single electrode AF4 across all EEG bands. The data is further analysed to find the classification accuracy for each EEG sub bands. The accuracy of sub bands are as follows: Delta 98.89%, Theta 98.65%, Alpha 98.89%, Beta 98.89%, and Gamma 98.89%. The result indicates that consumption of alcohol has a huge influence in brain signals and it can be detected using a single electrode.

Keywords: Electroencephalogram, EEG, alcoholic subjects



704/E3

Factors restricting the implementation of automating the tea auctioning system in Sri Lanka

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The study was carried out comprehensively based on analyzing, the Sri Lankan Auction System, where the sales are done on the British Out-Cry Method. The analysis carried out was to research if this system could be transmitted into an automated method. The purpose of this analysis is if it would be advantageous to transform the present system, which would in the long run eradicate malpractices which are occurring in the current sale system, and to obtain more transparency for the farmer and the buyer, and also to have a faster sale process in the pre-sales and post-sales which take place on a weekly basis. Qualitative and quantitative research methods were used for this purpose. A questionnaire was planned covering the relevant criteria. The main objective of the analysis was to identify the restrictions behind automating the present system. The sub objectives were (i) to scrutinize the level of Information technology/knowledge of the stakeholders and how conversant they were with E-Auction/E-bidding, (ii) to determine whether job transference (being moved to another department or being retrenched) was a threatening barrier, (iii) to assess whether the government is providing technical and monetary support. The governing body of the tea industry, being the government itself, was analyzed to determine whether such support is necessary and effective. The questionnaire was distributed and the data collected through fifty stakeholders in the tea trade over a period of one month. These were stakeholders who could influence such a critical decision, made in relation to the auction system. The collected data was analyzed through the Likert scale approach. Recommendations were given in relation to the results of the analysis, which had a more positive approach towards implementing an automation system. Recommendations were given to overcome the critical barriers raised in this research, which were identified within the Sri Lankan Tea industry. Moreover, other auction centers around the world (*e.g.*, India, Kenya, Indonesia, and Africa), and Stock Exchanges which successfully transformed from the platform to automation, also have been taken into consideration for analysis and recommendations.

Keywords: Automation, Tea Auction, Stakeholder, Out-cry, E-Auction,



705/E3

Application of user attributes and location tag similarities to handle the cold start problem in travel recommendation systems

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Travel recommendation systems that suggest top tourist attractions in a city to a user are a currently trending research topic. Since travel planning is time consuming and exhausting, researchers are experimenting with the possible applications of collaborative filtering in making recommendations to suit a user's personal travel preferences and context, to make travel planning easier. However, the existing travel recommenders implementing collaborative filtering do not pay much attention to robust approaches that can handle the cold start problem, which leads to limitations in their accuracy and usability. A major challenge in travel recommenders with regard to the cold start would be identifying a method to determine semantic similarities between users and locations in order to handle the new user and new location problems, respectively. Current solutions utilize pseudo users, random recommendations, and limiting recommendations within a predefined location set to overcome the above issues. This paper introduces a novel approach where the user travel histories are identified as check-ins on Facebook and used to recommend unvisited locations to a user via user-based collaborative filtering. Moreover, this approach resolves the new user problem based on the assumption that users belonging to similar age and gender groups, and will rate a given location similarly. The required user profiles including age and gender of the user can be extracted from the Facebook profile of the user. The new location problem is also resolved based on the assumption that a specific user will display similar preference towards similar locations. Similarities between locations are determined using "tag similarity" between two locations derived from the "types" tag given by Google Places API for any location in the world. The proposed solution was tested for accuracy using standard error metrics, and demonstrated that the novel approach introduced to handle the cold start is capable of providing recommendations with significant accuracy and robustness. The demand for the solution is apparent, as experiments established that the cold start problem is predominant in travel recommenders.



A Modified Firefly Algorithm to Solve Systems of Nonlinear Equations

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One of the most explored problems in applied mathematics, engineering and sciences is finding multiple solutions of a set of nonlinear equations. Most numerical methods that are being used to solve systems of nonlinear equations require the differentiability of the functions and the need of acceptable initial guesses. These made them less usable in solving complex systems of nonlinear equations. However, some optimization techniques; most of which are inspired by nature, have overcome these problems, but they are unable to provide more than one root approximation simultaneously. This paper presents a modified firefly algorithm [MODFA] providing a good solution for these drawbacks. It treats the problem as an optimization problem, which is capable of giving multiple root approximations simultaneously within a reasonable range. The new algorithm does not concern initial guesses, differentiability and even the continuity of the functions. It is capable of finding almost all root approximations within a provided range. The algorithm was tested with more than 15 systems of nonlinear equations with different number of variables. For testing, we have used both random and benchmark systems of equations in the literature. The error tolerance (accuracy) of the approximation was 10^{-2} . The execution time of the algorithm was also encouraging. Most of the numerical examples we have used, carry more than one solution. For a system of nonlinear equations, especially when the number of variables increases, it is hard to determine the number of roots within a given search space. When compared with the standard methods like Newton's method, it is worth mentioning here that our approach obtains almost all solutions within a single run. This is undoubtedly the main advantage of using the proposed algorithm.

Keywords: Firefly Algorithm, Systems of Nonlinear equations, Swarm Intelligence, Functions of several variables



707/E3

Online Mechanism for Prevention of Ragging and Violence in Universities/HEI, Sri Lanka: A System Study based on Call Centre Mechanism for Prevention of Ragging in India

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Gender inequalities and violence including that of sexual and gender-based violence in the Universities have been reported as significant shortcomings in the Sri Lankan University System. University Grants Commission (UGC) has recognized that without addressing these deeprooted inequalities and inequities within the system, Sri Lankan Universities cannot genuinely consider themselves to be centres of academic excellence. The UGC in Sri Lanka has the intention of setting up a Call Centre in order to create an environment of freedom and security that allows students and all university staff to pursue their study and work without discrimination and oppression. Anti-ragging mechanism in India is mainly managed through a 24*7 Call Centre. The Call Centre is the one stop centre to help students and other stakeholders on any university matter. One of the main objectives of setting up this call centre is to help students/victims immediately when they are being ragged. All forms of complaints on ragging are managed through the call centre, *i.e.*, centrally. The Call Centre and monitoring agency are to assure actions of universities/HEIs for each complaint. Each step of the actions or progress, including the voice tracks, is available on the cloud and can be accessed by the UGC and the victim. Actions taken regarding complaints by the university are uploaded to the online system through the Call Centre. The Call Centre represents students and follow-up actions until the complainant is satisfied. The findings of the study are a significant reduction ragging activities in India. The processes are set up to ensure that a complaint made by a student/complainant is addressed by the relevant authorities, and out of the various modes introduced, the 24*7 Call Centre has been the most effective in minimizing the ragging menace in India. A call centre at the UGC in Sri Lanka could be one stop Centre for all university matters. A successful adoption of this call centre software for all requirements of the UGC has the potential to provide better service delivery at reduced cost, and increase the efficiency, transparency, and responsiveness of the university sector.



708/E3

Irrational aspects in Information Technology (IT) Governance: A Synthesis of the Literature

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IT governance ensures that the organization's information technology supports the corporate strategies and objectives; thus the role of IT is to ensure the achievement of its organizational goals and objectives. IT governance is considered as the weakest link, though much research has been carried out to strengthen and integrate IT with the overall organizational governance structure. A comprehensive literature review was conducted in order to study how IT governance has evolved through the years, and literature findings are compared with the perspectives of institutional theory to identify irrational aspects in the evolution of IT governance processes. The institutional elements or the structure and the involvement of people in formal organizations were extensively studied in organizational theory. Out of the several organizational theories such as contingency theory, transaction cost theory, resource dependency theory, and network theory, that have evolved during the last few decades, the institutional theory could be considered from the theoretical perspectives as the best to explain the changes within organisations. Institutional theory cannot only be considered as a theory of organizational change but as an explanation of similarity and stability of organizational arrangements within a particular environment. The problem identified in this paper is the knowledge gap between the IT structural arrangement and the ways that contingencies affect the organizational IT decision making. This research was conducted with the assumption that the poor performance, IT maturity and evolution within organizations are due to lack of consideration of external and internal contingencies, and their effect on IT governance arrangements. Although research in IT governance has evolved in the directions of structural arrangement and the contingencies affecting IT governance, studies on the relationship between the directions, structural arrangement, and contingencies affecting IT are lacking in the literature. However the finding of this research indicates strong evidence of involvement of non-rationality in managing IT organizations. One such non-rationality factor involved is institutional forces. Organizations need to integrate irrational aspects of institutions with the rational internal aspects to present a richer explanation of complex IT governance phenomena in order to enhance overall performance.



Section F

801/F

Towards improved decision making: Valuation of ecosystem services provided by Pigeon Island National Park, Trincomalee, Sri Lanka

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Pigeon Island National Park (PINP) is a complex marine ecosystem, which is a part of an extensive system of marine habitats in the Trincomalee area. PINP provides a number of Ecosystem Services that include provisioning, regulating, supporting and cultural services. Although this has been included under the list of conservation, the PINP associated ecosystem is under the risk of degradation due to overexploitation of extractive users and additional pressure by booming tourism activities.

The present study makes an attempt to establish a gross, lower bound value for the conservation of PINP. This study has assessed the willingness-to-pay for conservation of the resource by users, in the form of a hypothetical scenario of village level cooperative society. The assessment was based on surveys covered at households (150) and visitors (170) separately. Key Informant discussions and Focus Group discussions were also held in order to gather qualitative information with the relevant stakeholders. When the average WTP of visitors is extrapolated to an annual basis, it amounts **Rs 60,702,487.68** per year, and when the average WTP of household respondents is extrapolated to the population in Kuchcaveli DS division on annual basis, it amounts to **Rs.1,653,566.40** per year. Secondly, two models were constructed using ordered probit method, and probabilities for each WTP values were predicted. WTP for each individual was generated using obtained probabilities. Average willingness to pay for each sample was calculated using the derived amounts and these values were used to extrapolate and derive a conservation value to the ecosystem. Accordingly, the conservation value as per the extrapolated average WTP was Rs. **34,872,212.16** for visitors and **Rs. 1,236,091.92** for households.

These amounts can be considered in calculating national income to express the contribution from this pristine ecosystem to the national economy and hence improve the effectiveness of policy decisions.

Keywords: willingness to pay, ordered probit regression, ecosystem services



802/F

**The living conditions of resettled families due to southern transport development project:
A sociological study**

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The STDP is the largest among all the development projects that have been implemented in Sri Lanka during the recent past. This project consists of a stretch of 124 km, from Kottawa to Matara, and runs through 64 GND and 21 DSD within four districts. A total of 5,683 persons on 951 hectares have been affected due to the construction of this project. The RIP is implemented by the RDA, jointly with the ADB and JBIC. The affected families have been compensated by the government, by granting money and lands. This study examines the livelihoods of the affected people of the STDP. The problem of the study was "How has the livelihood of people affected by the project improved as a result of resettlement by the STDP?" The main objective of this research was to carry out a comprehensive study on the living conditions of resettled families. Apart from that, the sub objectives of the study were to identify the level of infrastructure and sanitary facilities, to identify the conditions of livelihood, to find out the extent of mediation by the government and other organizations to develop these sources of livelihood, and to find out the present socio-economic conditions of the resettled people. A survey method was used for this study while a comparative method was also utilized. A questionnaire technique, interview and an observation technique were used to collect data. In addition secondary data have also been used.

Analysis of collected data revealed that the areas in which people were resettled have not changed so much. Sanitary facilities of the resettled families are of high standards. When their sources of livelihood are considered, it is not so satisfactory and has dropped with time. Most of them have built comfortable houses by using the compensatory funds. The second income generator of the resettled families is the son or daughter, and the majority of them are employed and receive permanent salaries. However, the resettlement has disrupted the business relationships of self-employed businessmen. Obtaining loans by resettled families is high, and most have obtained loans to build houses and not for investments. The RDA has intervened to upgrade their livelihoods. However, it has given priority to counseling rather than practical programmes. The members of resettled families are happy with the existing education and religious relations, but not with the political institute. Taken as a whole, they are happy with the existing social security of the area. A systematic programme is required to upgrade their status with the mediation of the government and non-governmental organizations, by focusing attention on second income generators and self-employment. Also, it should be emphasized that the government should prepare a plan to resolve any problems of land ownership and problems that may be faced by future generations. In addition, the sources of livelihood of the resettled families could be upgraded by creating a suitable environment, which would create positive attitudes among the resettled families.

Keywords: transport, development, resettlement, Southern Transport Development Project.

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803/F

Authentication of chemistry- based concepts in primary grade syllabi (3-5) through environmental- based activities

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Authentic learning can be defined as the learning which happens by actually participating and working on real-world problems. Such approaches based on environmental related activities can be used to inculcate a scientific outlook among students with opportunities for learning in real situations. The objective of this research was to identify the chemistry related environmental topics in the Primary Syllabus and to introduce teaching learning methods authenticated with environmental based activities, which can be applied to teach selected chemistry related topics.

Six topics, (i) water, (ii) food preservation, (iii) solid waste management,(iv) air,(v) soil, (vi) insecticides,in which are discussed basic concepts of chemistry, were selected from environmental-related activity units of grade 3, 4, and 5 of the Primary Syllabus for the study. The Chemistry components of each topic were taught applying environmental based activities and classroom based activities. Environmental based activities were authenticated with a variety of instructional approaches including field trips, mini projects and experiments. Classroom based activities were included classroom discussions, video presentations and role playing. The research sample consisted of 360 students, who were selected from the Western Province on a random basis. A group of 30 students were guided to learn each topic applying environmental-based activities as the experimental group, while an equal number of students were guided to learn the same topic applying classroom-based activities as the control group. As this is a mix method study, quantitative and qualitative data were collected to compare the achievements of students. Simple assessment rubrics were used to collect quantitative data, while the observations, artifacts and focus group discussions were used to collect the qualitative data. Quantitative data were analyzed using MINITAB 14 technical software. Qualitative data were analyzed using thematic analysis technique. Mean marks of the experimental groups for six assessments were 84.00, 88.00, 76.00, 84.00 88.00, 80.00, and mean marks of the control groups were 76.00, 64.00, 64.00, 72.00, 76.00, 68.00 respectively. Results of analyzed data emphasize that the students following the environmental based activities scored significantly higher in knowledge, attitudes, skills and behaviour on chemistry related environmental topics than the students who were exposed to the classroom based activities.

Keywords:authentic learning, environmental based activities, basic concepts of Chemistry, primary syllabus

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804/F

Investigation on perceived service quality and customer loyalty at *hela bojun* sales centers in Kandy district

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Hela Bojun sales centers were initiated to promote local traditional food items while empowering women entrepreneurs. Service quality is a vital factor for achieving customer satisfaction, which leads to customer loyalty and the long term success of an organization. The objective of this study was to examine the influence of perceived service quality on customer loyalty in *Hela Bojun* sales centers. Along with that, analyzing the relationships between perceived service quality and customer loyalty, analyzing the differences in customer loyalty with times of service, location and type of customers' visit to sales centers, and to give suggestions for further development of this market model were the specific objectives of this study. Customers of four *Hela Bojun* centers in Kandy District were the target population. A cross sectional study design was used as a research design. Data collection was done through a questionnaire with a sample of 120 respondents with 30 customers per each sales center. Multiple linear regression, one-way ANOVA, Mann-Whitney U test and frequency distributions were used to analyze the data. Results of the multiple linear regression ($R^2 = 0.522$) analysis showed that material (food quality), price, perceived trust, and customer satisfaction significantly (all $p < 0.1$) influence customer loyalty. Customer loyalty showed a significant difference in relation to the time of service with those coming in the morning been more loyal. Customers more than 50 years consume foods lower in oil. It is noted that differential strategies maybe needed given the differences seen in location, customers, and time of service. Increasing the space, improving the physical facilities and increasing the number of women entrepreneurs are the main suggestions provided by the customers who visit *Hela Bojun* sales centers.

Keywords: Service quality, customer loyalty, *Hela Bojun* sales center.

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805/F

**Assessing the factors contributing to career indecisiveness among undergraduates of
Peradeniya University**

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Career decision making is among the most important and inevitable tasks in one's life. As undergraduates, students have to make decisions regarding employment and further education. Career decision has lifelong consequences for the individual's psychological and physical well-being and overall quality of life. Making a career decision can be a difficult and a challenging task for many young people. In most of the university counseling centers it is a commonly found problem among undergraduates (Kelly & Pulver, 2003; Taylor, 1982). In career psychology, career indecision has drawn attention of many people and researchers due to its financial and psychological costs. Career indecisiveness is a commonly found problem among Sri Lankan undergraduates. The objective of the study was to assess the factors affecting career indecisiveness among undergraduates of the Peradeniya University. Multi stage stratified random sampling was adopted. The sample consisted of 410 final year undergraduates from four study faculties namely, Agriculture, Arts, Management, and Science. These faculties were selected since they do not lead students to a defined career path. Research was conducted as a cross-sectional study. Nine hypotheses derived from the conceptual framework were tested. Primary data were collected using a self-administered questionnaire based on nine factors. T-test was employed to determine a possible gender difference on career indecisiveness. Analysis of variance (ANOVA) was conducted to compare means of career indecisiveness among four faculties. To predict the relationship between career indecisiveness of undergraduates with independent variables, regression was conducted. A higher number of respondents displayed medium level of career indecisiveness. Results of the independent samples t-test revealed that there was no significant gender difference on career indecisiveness. Among all factors monthly family income, self-efficacy, family obligation, being a student in a particular faculty, and father's education level were significant ($R^2 = 0.357$, $p < 0.1$).

Keywords: career, career indecisiveness, career decision making, undergraduates, faculty

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806/F

Trends in Global Production and Regional Shifts of Major Pulse Crops: 1961-2013

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Globalization of diets, differences in access to technology, and factor endowments shape production and consumption of agricultural products. Pulse crops, a sub-set of legumes, play a prominent role in global nutrition security as a major ingredient of vegetarian diets and as an accessible source of protein to the poor. Pulses with their varietal diversity and culinary traditions also create cultural values in societies. This study aims a) to explain trends of global and regional pulse production, b) to understand reasons for shifts in regional shares, and c) to understand factors that influenced these changes. Asia, Africa, Europe, Northern America, Oceania, and Southern America were included. Compound growth rates and shares of production, harvested area, and yield of eight groups of pulses between, 1961-63 and 2011-13, were computed and compared. Data were obtained from FAOSTAT Database.

Global pulse production grew at 3.2 percent annually during the period. Area under all pulses grew from 68 to 80 million ha recording an annual growth of 2.3 percent. While Asia continued to be the major pulse producer, their production share declined from 57.4 to 45.5 percent. Production shares of Northern America, Africa, and Oceania increased respectively from 9.0 to 22.3, 2.7 to 9.9, and 0.1 to 4.3 percent. Africa reported the largest absolute production increase of 12 million tons. Shares of Africa, Northern America, and Oceania in global harvested area increased. Dry beans, accounting for 37 percent of area harvested of all pulses, continued to be the leading crop. Global harvested areas of cowpeas, lentils, pigeon-peas, and bambara beans increased while that of dry-peas, broad-beans, vetches and lupins declined. Notably, pulses NES (not elsewhere specified) has reversed the declining trend of area since early 2000.

When compared to that of cereal crops, growth rates of pulses are lower. Annual average global lentil production quadrupled. The share of Asia in lentil production declined from 71 percent to 46 percent, while Northern America's meager global production share of two percent increased to 40 percent. This indicates a shift of production to high productive and profitable larger farms from smallholder dominated Asia.

Keywords: compound growth analysis; additive decomposition; harvested areas; food crop availability; land use

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807/F

Changing shares and value growth of destination markets for exports from Sri Lanka

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The export sector of Sri Lanka has transformed from a primary exporter to a more value added one. Exporters have to face a global trade environment that is dynamic, competitive and hostile. Sustained partnerships with key export partners are crucial to assure adequate revenues to domestic industries. Understanding patterns of performance of export destinations are useful to policy makers in planning and intervening with supportive or mitigation measures, in view of export sustainability. The objectives of this research were, a) to understand patterns of shares of destination countries for exports from Sri Lanka, and b) to identify potential reasons for changes.

Data extracted from documents published by the Sri Lanka Export Development Board (SLEDB) for 2007-2015 were used for the analysis. Supplementary data were obtained from Central Bank of Sri Lanka annual reports. Ranks based on share of destination markets in total export values and their changes were analyzed using tabular methods.

Value of exports in current terms were USD7.6 to 9.8 to 20.8 billion, respectively, in 2007, 2012 and 2015. The top 10 export destination countries accounted for 72 % of total exports in 2007. This was 62% and 82% in 2012 and 2015 respectively. United States, the United Kingdom, India, Italy, Belgium, Germany, Russian Federation, United Arab Emirates (UAE), Japan and Islamic Republic of Iran were top ten export destinations in 2012. Value of exports to only three destinations identified within top 10 in 2012, *i.e.*, the US, Germany and the UAE increased in 2015. The US, the UK, and India retained their ranks throughout the period. Germany moved from 6th position in 2012 to 4th position in 2015. Italy, Belgium, UAE, and Japan continued to hold their membership as did in 2012. China recorded a remarkable progress by moving from its rank of 17 in 2012 to nine in 2015. Exports to top destinations grew by 184% from 2012 to 2015 while that of other destinations was negative during the period. Top destinations continue to play an important role. Analysis of import patterns of major destination countries from other countries may draw further insights into future potential to sustain exports.

Keywords: export performance, market analysis, growth analysis value shares, business sustainability

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808/F

**How does service quality impact on customer satisfaction? A case with LOLC Finance PLC –
Sri Lanka**

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This research was conducted to find the impact on customer satisfaction when delivering a quality service by the staff of LOLC Finance PLC by measuring variables such as responsiveness, assurance, tangibility, empathy, and reliability. The objectives of the research were to find the willingness and the responsiveness of the staff to help the customers, to find out how knowledgeable and courteous the staff are in convincing and building trust among customers, to find out how the organizational appearance, personnel, and communication affects customers in decision making, to find out whether the customers gets personalised attention from the staff members, and to find out how reliable the staff are to deliver the promised service dependably and accurately. The report further elaborates on the background and the importance of carrying out such research. Under the literature review, theories related to service quality and perceived service quality were discussed, while looking at the similar studies done in different contexts relating to perceived service quality. The SERVQUAL model was identified as the analytical framework to measure service quality. Perceived service quality was identified as the dependent variable while responsiveness, assurance, tangibility, empathy and reliability was identified as the independent variables. A quantitative research project was conducted by adopting a positivist, deductive approach. A questionnaire was used as the data collection instrument and data was gathered from SME (small to medium enterprise) customers of Metro branches of LOLC Finance PLC. 154 responses were received from the selected sample. Data gathered were analysed using descriptive analysis, descriptive statistics, correlation analysis and regression analysis. It was revealed from the findings that assurance and tangibility was more significant than the other independent variables.

Keywords: service quality, customer expectations and perceptions, perceived service quality, SERVQUAL

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809/F

Divergence between per capita GDP and per capita median household income and the economic wellbeing of Sri Lanka during last ten years

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Divergence between GDP per capita imputed by national accounts and the monthly income computed by household income surveys has been of concern in many countries in the recent past. Sri Lanka experienced a robust annual growth in the recent decades and was one of the fastest growing economies in Asia. However, it is widely perceived that this growth has not been capable of increasing the purchasing power or the real household income of a wider section of the population and the gap between the per capita GDP and the real household income is widening. This study addresses this widening gap and the meagreness of per capita GDP as a measure of economic wellbeing in Sri Lanka. The study compares the GDP per capita and per capita income/expenditure computed by Household Income and Expenditure Survey (HIES) in the last ten years. Published data from HIESs and GDP data are analysed by converting to real values using GDP deflator and the Colombo Consumer Price Index (CCPI). From 2002 to 2012, the real GDP per capita grew at a rate of 6.67 % while median per capita household real income grew only at 3.78 %. From 2009 – 2011 when the highest per capita GDP growth was recorded in the country, the median per capita household income shows a stagnating growth. Also 28% of the per capita GDP that had been received by an individual in a median income household in 2002 has come down to 24% in 2011. No significant shift in the per capita monthly real income distribution curve is observed from 2009 to 2012. Moreover the budget share on food of an average Sri Lankan during the period from 2006/07 to 2012/13 has not declined. The study highlights the limitations of per capita GDP as a measure of well-being in Sri Lanka. Household income/consumption measurements can better explain the real household purchasing capacity and it is needed to take into account the market and non-market incomes in estimating the household income.

Keywords: Per capita GDP, median household income, divergence

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810/F

Impact of Customer Attire on Price of Goods and the Service Quality in Small and Medium Scale Business Context

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The present study tests the impact of customer attire on service quality, quoted price of goods, and pressure to purchase in small and medium scale textile businesses in the Kandy area. The study seeks to identify the salesperson's initial categorization of customers using their attire. The study also seeks to establish the relationship between dress style and service quality, quoted price for goods, and pressure to purchase. The theoretical basis of the research was provided by Bitner's Servicecape Model and the SERVQUAL Model. The research was done in two steps. In the initial stage, face-to-face interviews were conducted with sales employees in small and medium scale textile shops. The study found that the sales employees categorize the customers using their attire with respect to quality and style of the dress, shoes, hand bags and hairstyles. The second stage of the study was designed as a within subject experimental design, in which mystery shoppers visited textile shops in the three different appearances (sloppy, clean and tidy casual, fashionable). Mystery shoppers completed structured questionnaires for every visit. Three hypotheses were tested using a repeated measures ANOVA and *post hoc* comparisons. Supporting the research hypotheses, dress had significant effects on sales employees' decisions on level of service quality, pressure to purchase and price quoted. Customers wearing branded and fashionable or clean and casual clothing received better service and encountered higher pressure to purchase than those dressed sloppily, while the sloppy customer was offered lower prices. The results contribute to the understanding of how customer segmentation occurs in small and medium scale retail environments where prices are unfixed.

Keywords: customer attire, service quality, price quoted, mystery shopper

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811/F

Factors affecting the loan repayment behaviour and credit risk of farmers in *Kotiyagala* village in Monaragala District

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Capital investments in agriculture and loan repayment are important in the smooth running of farm business entities. Analyzing the loan repayment behavior of farmers is critically important with the adoption of modern commercial farming operations in Sri Lanka. With this backdrop, a study was carried out in *Kotiyagala* village (6.772544N, 81.530066E) in the Monaragala District. One hundred farmers were selected randomly to collect information. Both structured questionnaire and small group discussions were used for collection of primary data. A multiple regression model was used in the process of data analysis. Independent variables have an impact on the paid credit amount (the dependant variable) at significant level of 95%. Results show demographic characters like age ($p=0.01$), income ($p=0.01$), and family size ($p=0.02$) have a strictly significant impact on loan repayment. In contrast, interest rate ($p=0.003$) and loan application cost ($p=0.002$), which are lender specific characters, also significantly impact on loan repayment. The borrower specific characters like value of collateral ($p=0.00$) and possession of farm machinery ($p=0.001$) have a significant impact on the particular loan repayment. As a policy measure, the rural farmers need proper micro credit facilities and affordable interest rates to overcome the inefficiencies in the loan repayment. Further, farmers who currently borrow money from less organized financial markets, due to collateral issues, must be supported via such introductions.

Keywords: Loan repayment, Capital investments in agriculture

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812/F

Stress and coping among final year medical students of Sri Lanka

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Student stress is common in medical education, and it often exerts a negative effect on their academic performance and physical and psychological wellbeing. These negative effects are associated with not only the study period, but also their future, when they are practising as physicians. Stress levels are high during the final year of study, as students have to deal with the pressure of graduating and making career decisions. Therefore the general objective of this cross sectional study was to examine the prevalence of stress among the final year medical students of Sri Lanka through the specific objectives of assessing the levels of stress, analyzing the sources of stress, and the coping strategies used by them to overcome the stress. This study was carried out among 180 final year medical students of University of Peradeniya, University of Kelaniya and University of Rajarata. Two stage stratified random sampling was practised to select respondents. Perceived stress was assessed using the perceived stress scale. The Professional Student Stress Survey was used to measure factors of stress and Carver's Brief COPE was used to identify the coping strategies. A majority of the sample recorded a moderate degree of stress. As factors of stress, academic pressures, personal issues, professional identity, and avoidant based coping strategies showed positive correlations ($P < 0.1$) with the perceived stress of students. Academic performance (CGPA) and emotion based coping strategies have ($P < 0.1$) negative correlations ($P < 0.1$) with the perceived stress. There was no significant difference of stress found among the universities ($P < 0.1$). Also this study found no statistically significant difference of stress between genders ($P < 0.1$). With reference to coping strategies, there was no difference between males and females ($P < 0.1$). The findings indicate the necessity for stress management programs in the medical faculties of Sri Lanka.

Keywords: stress, medical students, coping strategies

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813/F

Factors influencing the choice of organic and non-organic farming among spice growers in Kandy District

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The realization of the importance of organic produce has caused a rapid growth in demand over the past two decades. Despite government efforts at promoting organic agriculture with favourable policy changes and promotions, still very few farmers in Sri Lanka are involved in organic agriculture. Previous studies have shown that farmers choose to adopt agricultural practices for a variety of reasons. But very few studies have focused on understanding local farmer motivating factors related to adoption of organic farming practices. The study utilizes the binary logistic modelling to analyse determinants of the decision to adopt organic farming. Motive factors and attitudes are measured using scales and ranking systems. The research was conducted as a cross sectional study with a pre-tested interview schedule administered to organic and conventional spice farmers in the Kandy district. A sample of sixty farmers was used in the study. The results indicate that organic farmers, compared to their conventional counterparts, are more likely to be older, more educated, have more interactions with local organizations, and are part time farmers. The study also indicates that organic farmers are mainly driven by perceived health benefits of adopting organic agriculture while conventional farmers have stronger economic motivations. Exploration of attitudes of farmers shows that conventional and organic farmers have significantly different attitudes towards their respective agriculture practices. Results can be utilized by extension services to create better extension programmes to promote organic farming in an effective and efficient manner. Also the results suggest the importance of consideration of non-economic aspects of farmer motivation explored in this study, when formulating policies to increase the adoption of organic agriculture in local farming communities.

Keywords: Adoption, motivation, binary logistic, organic

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814/F

Teaching sustainable engineering using disassemble-analyse-assemble (DAA) activities and lifecycle assessment (LCA) approach in first year engineering education

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There is a growing realization among engineering educators that a new vision for the education of engineers needs to evolve to keep up with the challenges of tomorrow. In such context, introduction to sustainable engineering is a new module introduced into the first year, first semester of the engineering curriculum at the Faculty of Engineering, Sri Lanka Institute of Information Technology in Sri Lanka in 2014. Sustainable engineering education is interdisciplinary in nature, making it more challenging to teach to the first year engineering undergraduates. Many past studies have demonstrated that active learning techniques would be more effective in terms of learning interdisciplinary skills and systems thinking. Usually, reverse engineering is a technique used in engineering education to teach engineering design, most in mechanical and electrical engineering disciplines, but it has not been widely used in teaching sustainable engineering. Life cycle thinking is very important in engineering education as it would provide room for making informed decisions by engineers, when they design products, systems etc. The objective of the paper is to present how the steps of life cycle assessment (LCA) and reverse engineering can be integrated in content delivery and assessment design of a first year sustainable engineering module, highlighting active learning pedagogies. The structured approach used in reverse engineering and life cycle analysis approach enabled the fresh engineering undergraduates a smoother transition from high school to university learning environment. This was evident through the active engagement during the workshop sessions as well as the grades obtained for the term project when compared to the previous year.

Keywords: assessment, reverse engineering, student centered learning, systems thinking

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815/F

Analysis of consumer perceptions for making purchase decisions on fruit beverages in Sri Lankan supermarkets

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Four leading supermarket chains currently operate in Sri Lanka. These supermarkets provide four major fruit beverage categories of Ready to Drink (RTD) fruit beverages, fruit nectar, fruit cordial, and fruit concentrates. As a result of the drastic decrease of popularity in carbonated beverages due to their numerous health issues, a fast market growth and market expansion was recently achieved by the fruit beverage industry. This study was conducted in the Colombo city to identify the consumer perceptions that drive the purchasing decisions of consumers on fruit beverages and determine the major market segments. Two separate questionnaires were included in the study for both qualitative and quantitative analytical purposes. A survey was conducted in 46 supermarkets with 300 randomly selected customers, during weekdays and weekends. Results of the study identified fruit nectar as the most preferred fruit beverage category among the respondents. The attributes that drive the consumer perceptions to purchase nectar are calculated using discrete choice model and choice based conjoint analysis. Among them "Brand name", "Flavour", "Volume", "Price" and "Sugar levels" have 34%, 20%, 20%, 21% and 4% aggregated importance respectively. Well-known brand names have higher consumer preference and consumers are more likely to consume mango nectar. Also, consumers prefer nectar at the affordable middle level price range. Factor analysis was conducted to identify the major factors that drive the market, and a cluster analysis was conducted to divide the sample population in to four segments. Four factors focused on consumer behavioural segmentation were identified as "Information seeking factor," "Neophile factor," "Convenience factor," and "Health conscious factor." Among the four marketing segments, the first marketing segment represents 30% of the consumers and includes a higher representation from convenience and health conscious factors. Other marketing segments have 13%, 31% and 21% representation of the population respectively and carry characteristics identical with the above-mentioned factors. Identification of behavioural segments and their product attributes in the fruit beverage category would help marketers in designing their marketing strategies.

Keywords: fruit beverages, choice based conjoint analysis, factor-cluster segmentation

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816/F

**Use of hedonic models to value urban disamenities: A case study of Meethotamulla
dumpsite, Sri Lanka**

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Municipal Solid Waste (MSW) has become a major problem worldwide. The challenge of environmentally sound disposal of such waste has become critical in many developing nations, where open dumping is the most common method of disposal of such waste. This has resulted in creating mountains of solid waste dumps in urban centers posing many externalities, even fatal, to surrounding communities. The discussion on such externalities however is on the rise, but the important factors such as the impact on landscape disamenities caused by dumpsites on the quality of life is often undermined. This study is based on the *Meethotamulla* dump site, an open dump site located in the *Kolonnawa* Municipality in Western Province of Sri Lanka. Until the collapse of the site, 850 metric tons of MSW had been dumped daily and around 1000 households have been directly affected around the dumpsite. The main objective of the study is to calculate the marginal value of disamenities caused by an open dumpsite using a hedonic model.

A household survey was conducted using a pre-tested questionnaire among the surrounding community of the dump site; a total of 117 households were surveyed using stratified random sampling along three directions from the dump from May to August 2016. The structural, neighborhood, and environmental attributes and transaction data were collected directly from households to estimate the disamenity effects of the dumpsite. Three basic forms (linear, semi log and log) were tested using MINITAB 14.1 software by running multiple linear regression analysis, with ordinary least squares (OLS) method being used to estimate model parameters.

The results from the selected model (log-linear) showed that the value of the property will be decreased by a factor of 0.185 if the dumpsite is visible. Accordingly, total loss of aesthetic value was estimated as Rs. 1,265.8 million whereas the annual loss of aesthetic value was Rs. 37.56 million. The loss of aesthetic value per ton of MSW was calculated as Rs. 121, which is less than a US\$ 1. Given the typical estimates from other studies ranging from US\$ 2.4 -37 per ton of waste, this may be an underestimation of the actual loss of amenity perceived by the surrounding community.

Keywords: Municipal solid waste, open dump site, urban disamenities, hedonic model

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817/F

Competitiveness of black tea exports from Sri Lanka in the Japanese market

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Tea is the most important agricultural export from Sri Lanka. Black tea is the leading segment of Sri Lankan tea industry accounting for 98.6 percent of the total tea export value. Japan is the most sophisticated tea market in the world. As Japan is not a black tea producing country, its black tea market completely depends on imports from other countries. Japan is one of highest revenue earning markets for two Sri Lankan black tea products, tea bags less than 4g and bulk tea of more than 10kg in weight. The Sri Lankan tea industry has recently shown a decline in black tea production due to irregular weather patterns in tea cultivating districts and long-term existence of lower yielding older plantations. The high cost of production, due to labor deficits and poor growth in value addition, have become challenges to maintain competitive tea prices in the export market. Competitiveness describes dimensions such as profitability, resource usage efficiency, and productivity of a certain producer when compared with other producers in a same market. Determination of competitors, level of competitiveness, and price effects is important for understanding market dynamics and planning within a highly unstable market environment. The main rivals of Sri Lankan black tea in the Japanese market were identified using data from Japan's Ministry of Finance. The Export Similarity Index was used in this exercise. Market concentration and competitiveness were measured using the Hirschman-Herfindahl Index and Revealed Comparative Advantage index respectively. The econometric import demand model to analyze price effects on competitiveness was estimated using Seemingly Unrelated Regression technique. United Kingdom, France, Malaysia, Kenya and Indonesia are the main rival countries of Sri Lanka. The Japanese market is highly concentrated for black tea as Sri Lanka occupies the highest market share around 60 percent. Sri Lanka's competitive power is higher than that of Kenya, and Indonesia for tea bags and that of United Kingdom, France, Malaysia for bulk tea. Sri Lankan export price of tea has a significant effect on import demands of United Kingdom, France and Malaysia for tea bags. For bulk tea Sri Lankan export price has a significant effect on France and Malaysian import demands.

Keywords: Hirschman-Herfindahl index, export similarity index, revealed comparative advantage, import demand model, seemingly unrelated regression

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818/F

Discrepancy between country's resource capacity and level of fabrication: Prospects for Sri Lankan gem and jewellery industry

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The export sector of the gem and jewellery industry in Sri Lanka plays a vital role, contributing immensely to foreign exchange earnings of the country's economy. The industrial value chain begins with gem mining and ends with retailing of jewellery. Every step involves trading, resulting in bulks of semi-finished products being exported. There is a loss of premium due to incomplete value addition. Statistical data illustrates a clear disparity in terms of revenue generated through gem exports as opposed to jewellery exports. Thus, the discrepancy between the country's resource capacity and its level of fabrication has inspired this research. The main objective of this study is to explore the key factors, which cause the low competency in value addition in the gem and jewellery industry in Sri Lanka. The required data was collected through an extensive literature survey and several face-to-face, in-depth interviews with experts in the gem and jewellery industry. A purposive sample was selected from the export gem and jewellery segment. The results of the data analysis concluded that there are six major constraints affecting the low production and exporting of gem set jewellery in Sri Lanka, namely, lack of innovation, lack of technology, lack of market, lack of competent manpower, lack of financial resources and lack of integration and long term plans. Addressing these needy matters will lead to novel prospects for the gem and jewellery industry in Sri Lanka.

Keywords: Gem and jewellery, value addition, export, competitiveness

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819/F

Success factors of software/ technology acceptance in language translation sector in Sri Lanka

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The unified theory of acceptance and use of technology (UTAUT) proposes that performance expectancy, effort expectancy, social influence, and facilitating conditions predict behavioral intention towards the acceptance of Technology. The theory further proposes that facilitating conditions and behavioural intention predict use behavior in the acceptance and implementation of software/ technology for the language translation sector in Sri Lanka. Therefore, 74 questionnaires were distributed among translators, editors, and Christian church leaders. Furthermore, an Inference analysis and descriptive analysis were conducted in order to assess the efficiency and the acceptance of new technology / software in the translation and editing in Sri Lanka. According to the conducted research, effort expectancy and social influence are the factors that have the highest correlation of 0.90 and 0.91 respectively. Additionally, one level increase of social influence will increase efficiency of software/ technical acceptance by a factor of 0.47 (as a percentage 47%). A single level of increase of performance expectancy will result in an increase of efficiency by 0.16 (as a percentage 16%). One level increase of facilitating conditions will result in an increase of efficiency by 0.09 (as a percentage 09%). Also, one level increase of effort expectancy will result in an increase of efficiency by 0.35 (as a percentage 35%). According to Table 6, t-stat for performance expectancy and facilitating conditions are lesser than 1.96. Furthermore, the t-stat value of effort expectancy and social influence are more than 1.96. Therefore, effort expectancy and social influence are positively correlated and significant.

Keywords: UTAUT, Efficiency, Technical acceptance, Facilitating conditions, Social influence, Performance expectancy, Effort expectancy.

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Poster Presentations



901/A

Knowledge of teachers regarding fine motor skills of children with Down syndrome in the context of special education in Southern Province of Sri Lanka

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Fine motor skills (FMS) are essential functional performance skills for children to interact within the classroom environment successfully. Children with Down Syndrome (DS) are predisposed to specific challenges due to deficits in FMS. This study is aimed to determine the knowledge of teachers regarding FMS of children with DS in the context of special education in the Southern Province of Sri Lanka. A cross-sectional study was conducted among all consenting eligible teachers (n=147) working in government schools of the Southern Province of Sri Lanka. The self-administered questionnaire was developed based on literature and expert opinion, to assess awareness, factors affecting, and interventions to improve FMS. To determine the level of knowledge, a score was assigned for correct responses resulting in total scores for each of the three domains. Good knowledge was defined as having a score equal to or above the median. The associations between teachers' characteristics and their knowledge of FMS were assessed using the Chi-square test. Approximately 93% of subjects were females with a mean age (\pm SD) of 43.1 (\pm 10.1) years. Approximately 30% of teachers have had training in special education and 83% had children with DS in their classrooms. A good knowledge on awareness of, factors affecting, and interventions to improve FMS were observed in 74.1% (n=109), 66.0% (n=97), and 68.0% (n=100) respectively. Sixty one percent (n=89) of teachers had good overall knowledge of FMS. Teachers who had a training in special education had a significantly higher knowledge of FMS (p=0.042). The teachers' knowledge of FMS was significantly associated with being aware of FMS difficulties in children with DS (p= 0.046). The results suggest that teachers were less knowledgeable in factors affecting FMS and interventions to improve FMS of children with DS. Teachers having special education training had significantly better knowledge of FMS. Further research is needed to determine whether teachers working in the context of special education in Sri Lanka having intensive training improve the FMS of children with DS.

Keywords: Down syndrome, fine motor skills, special education, knowledge

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902/A

***Asparagus racemosus* (Willd) of Sri Lankan origin: Physico-chemical, phyto-chemical and nutritional profiles of root powder**

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Plant based drugs are used worldwide as aphrodisiacs since time immemorial, and the use of ethnopharmacological methods to increase reproductive potential has dramatically increased globally. One of the drawbacks in the acceptance of the herbal extracts among the scientific world is the lack of chemical standardization. *Asparagus racemosus* is one of the well-known medicines in Ayurveda, which is considered as the “Queen of the herbs” due to its abundant medicinal effects. It has broad economic importance worldwide as a medicinal plant as well as a research oriented plant mainly due to its aphrodisiac properties. The present investigation was to standardize the roots of Sri Lankan grown *A. racemosus* for the first time by the determination of physico-chemical, phytochemical, and nutritional profiles, using WHO guidelines and standard protocols. The analysis of physico-chemical parameters showed that the roots of *A. racemosus* consisted of $9.7 \pm 0.2\%$ total ashes, $4.4 \pm 0.2\%$ water soluble ashes, and $0.5 \pm 0.0\%$ acid insoluble ashes. The levels of tested heavy metals (Hg, As, Cd, and Pb) were below the WHO acceptable limits and microorganisms including *Staphylococcus aureus*, *Escherichia coli*, *Coliforms*, *Salmonella*, yeast, and moulds were not present. Saponins, tannins, flavonoids, terpenoids, phenols, and steroids were present in the root extract. Twelve prominent spots bearing R_f values of 0.03, 0.05, 0.08, 0.11, 0.17, 0.19, 0.27, 0.41, 0.49, 0.67, 0.81, and 0.93 were present in the TLC fingerprint profile of the dichloromethane root extract in dichloromethane: ethyl acetate: cyclohexane (1: 4: 0.5) as the solvent system. The percentage of crude protein was 7.8 ± 0.2 , total fat was less than 1%, the crude fiber percentage was 28.9 ± 0.6 , and carbohydrate was 37.2%. The energy value of the sample was 180 kcal/100g. In conclusion this is the first report on physico-chemical, phyto-chemical and nutritional profiles of Sri Lankan grown *A. racemosus*. Further, this study can be used as reference standards for the roots of *A. racemosus* of Sri Lankan origin.

Keywords: *Asparagus racemosus*, physico-chemical and phytochemical analysis, nutritional properties.

Acknowledgement: University Grant Commission, Ward Place, Colombo 7, Sri Lanka, is acknowledged for financial assistance.



903/ A

The efficacy of Novaluron as an active ingredient in Autocidal Gravid Ovitrap (AGOs) to control *Aedes albopictus* (Skuse)

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Dengue is an important mosquito-borne viral infection in Sri Lanka and dengue virus is transmitted to humans primarily by *Aedes aegypti* (Linnaeus) mosquitoes. *Aedes albopictus* (Skuse) is considered as the secondary vector which has a wide distribution in Sri Lanka. Vector control is the best strategy to control the disease. Therefore, novel tools to control dengue vector mosquitoes have become the need of the hour. Autocidal Gravid Ovitrap (AGO) facilitates an oviposition site for female mosquitoes but results in Emerging Inhibition (IE) of adults due to the presence of an insecticide or Insect Growth Regulator (IGR) at lethal dosages. Novaluron is an IGR developed recently and it acts as a chitin synthesis inhibitor. Our objective was to identify the efficacy of Novaluron as an AGO to control *Ae. albopictus* under laboratory conditions. Insectary-reared third instar *Ae. albopictus* larvae were exposed to concentrations ranging from 5 ppm to 0.5 ppb Novaluron in 40 black colour 200 ml ovitraps following World Health Organization (WHO) guidelines to determine adult Emerging Inhibition (IE%). A batch of third instar larvae (n=30) introduced to each ovitrap were exposed for 24 hours. A similar number of untreated ovitraps were used as controls. Once all mosquito larvae were demised, another batch of 30 larvae was added to each of the treated and control ovitraps to identify the residual effect without re-filling with water. Calculated LD₅₀, LD₉₀ and LD₉₉ values were 0.00029 ppm, 0.00038 ppm and 0.00048 ppm respectively at the 5% significance level. During the laboratory studies, the effective minimum concentration giving 100% mortality (IE 100%) was 0.00048 ppm (0.5 ppb) and all the mosquito larvae were demised after 14 days from the initial introduction. All the mosquito larvae in the next batch were demised by day 28. The test cups were dried completely by day 30. Therefore, the residual effect of Novaluron at this concentration could be seen up to 28 days. Results reveal the potential of using Novaluron treated ovitraps to control dengue vectors at household level.

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904/A

Effect of hot water extract of *Tragia involucrata* L. on lipid profile in high fat diet STZ induced diabetic rats and normoglycaemic rats

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Tragia involucrata L. (Family: Euphorbiaceae) commonly known as *Wel kahambiliya* (Sinhala) and Indian stinging nettle (English) is a medicinal herb widely used in Sri Lankan traditional medical system and Ayurveda. The plant shows biological activities such as anti-diabetic, hyperlipidaemic, anti-inflammatory, analgesic, anti-cancer, anti-microbial, diuretic, antioxidant, etc. The present study aims to investigate the effect of the hot water extract of *Tragia involucrata* L. at a dose of 550 mg/kg on lipid profile in high fat diet STZ induced diabetic and normoglycaemic male Wistar rats. Diabetes was induced by providing 60% high fat diet for 21 days, and on the 22nd day freshly prepared Streptozotocin (30 mg/kg) was administered through intra-peritoneal injection. Tail bleeding were performed seven days after injecting streptozotocin to screen the fasting blood glucose levels. Rats with blood glucose levels higher than 150 mg/dL were selected for the experiment. Twenty four adult male Wistar rats were divided randomly into four groups (n=6). Group I (Non diabetic negative control) non-diabetic rats were orally treated with distilled water (1 mL/day), Group II (Diabetic control) diabetic rats were orally treated with distilled water (1 mL/day), Group III (Diabetic reference group) diabetic rats were orally treated with 150 mg/kg Metformin/day, and Group IV (Diabetic test group) diabetic rats were orally treated with the plant extract at a dose of 550 mg/kg/day for 28 days. On the 29th day blood was drawn from overnight fasted animals and blood glucose, concentrations of triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), and total cholesterol were measured. Results showed that the plant extract significantly ($P > 0.05$) reduce Triglyceride levels (by 51.4%) and VLDL (very low density lipoprotein) cholesterol levels (by 43.8%) and significantly ($P < 0.05$) increases HDL (high density lipoprotein) cholesterol level (by 34.9%). The plant extract also significantly ($P > 0.05$) reduces blood glucose levels at a dose of 550 mg/kg. In conclusion, the hot water extract of *Tragia involucrata* L. whole plant significantly makes changes in the lipid profile by decreasing VLDL cholesterol and triglycerides, and increasing HDL cholesterol levels in adult male Wistar rats.

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905/A

Identification of bacteria in patients with bronchiectasis and suspected lung cancer: A Preliminary Study

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Respiratory diseases are a group of diseases, which affect and burden humans throughout the world. A diseased lung may present altered diversity of commensal bacteria as well as pathogenic bacteria, depending on the disease type and severity. According to scientific research carried out, lung cancer and bronchiectasis are two diseases where microbial dysbiosis is observed. As a tropical country, Sri Lanka accounts for many lung cancer and bronchiectasis patients, and it is timely to address the effect of bacterial microbiome. The aim of the study was to identify culturable bacterial microbiome of respective patients. The ethical clearance for the study was obtained by Teaching Hospital, Kandy. The study population consisted of lung cancer suspects (according to symptoms) (n=20), and bronchiectasis patients (n=20). Oropharyngeal (OP) swabs and bronchoalveolar lavage (BAL) samples were collected from all patients as per the representation of upper and lower respiratory tract, respectively. Samples were collected and processed for culturing on Luria Bertani (LB) medium and on Lowenstein Jensen (LJ) medium. The obtained cultures were Gram stained. Following DNA extraction by the standard CTAB (N-Cetyl-N,N,N-trimethylammonium bromide) method, 16S rDNA gene amplification was carried out. The amplified DNA was sequenced to identify the bacterial species present by standard nucleotide BLAST. No cultures were obtained on the LJ medium, and the LB medium yielded 60 isolates. Gram's staining resulted in Gram positive rods (n=5), Gram negative rods (n=41), Gram positive cocci (n=3), and Gram negative cocci (n=11). Bacterial sequences belonging to six families, viz., Enterobacteriaceae, Bacillaceae, Enterococcaceae, Neisseriaceae, Pseudomonadaceae, and Paenibacillaceae were identified. Further analysis to genus level revealed seven genera, viz., Enterobacter, Klebsiella, Bacillus, Enterococcus, Neisseria, Pseudomonas and Paenibacillus. Therefore, the organisms belong to the two phyla, Proteobacteria and Firmicutes. **The commonest were genera Enterobacter and Pseudomonas in both Lung cancer (27.3% each) and bronchiectasis (28.5% each).** An important observation made was that OP swabs failed to produce cultures compared to BAL. The results further confirm that chronically diseased airways tend to become the habitat of many bacteria belonging to phylum Proteobacteria. A limited but supportive impression can be gained from identifying culturable bacteria, yet molecular methods might provide a specific insight.

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Mathematical Modelling to Forecast Dengue Epidemics in Gangawata Korale and Kandy Municipal Council Medical Officer of Health (MOH) Divisions in Kandy District, Sri Lanka

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Dengue caused 150,407 cases within the first 8 months of 2017, becoming the most challenging health issue in Sri Lanka. The limitations in human resources, technology, and public awareness, along with poor coordination for community mobilization have been key difficulties in controlling dengue. A model to forecast dengue epidemics allows the local authorities to take necessary and timely precautions, especially for vector control. This study attempts to formulate an empirical model for predicting dengue incidence in the Medical Officer of Health (MOH) areas of Gangawata Korale and Kandy Municipal Council (KMC) in the Kandy district. Secondary data such as dengue cases notified to MOH offices from January 2009 to December, 2015 and monthly vector indices [Breteau Index (BI), Container Index (CI), and Premises Index (PI)] for *Aedes aegypti* and *Aedes albopictus* were acquired. The collected data were arranged at the Grama Niladhari Division (GND) level and the step-wise multiple regression modelling technique (in SPSS) was used to develop the empirical model for predicting dengue incidence. The model was validated for 2016, by using Coefficient of performance (CP_A'), distribution of residuals, and Relative Error (RE). The results showed that BI and CI of *Ae. aegypti* and CI of *Ae. albopictus* had positive correlations with the dengue incidence, while the rest indicated negative relationships. Among the correlations observed, only CI for *Aedes albopictus* and BI and PI for *Aedes aegypti* were statistically significant ($p < 0.05$ at 95% level of confidence). The following empirical model gave the best predictive power of dengue incidence within the study area.

$$\text{Dengue cases} = 28.87 + 2.61 \text{ BIA} - 3.42 \text{ PIA}$$

where, BIA is the Breteau Index of *Ae. aegypti* and PIA is the Premises Index of *Ae. aegypti*. The predictions of the model were reliable based on statistical values of 75.1% and 94.5% of residual points within $\pm 1SD$ and $\pm 2SD$ ranges, $CP_A' = 1.89$ and $RE = +0.75\%$. It was evident that only BIA and PIA had a significant influence on the active transmission of dengue within the study areas, emphasizing the dominant role played by *Ae. aegypti*. This approach can be used for predicting dengue incidence based on entomological indices, enabling timely precautionary action for vector control.

Keywords: Dengue, vector Indices, regression modelling

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907/A

Dengue vector abundance and probable breeding habitats among selected school premises in the District of Gampaha, Sri Lanka

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The Gampaha District has reported the second highest incidence of dengue during the last decade. Studies in Western province highlighted the presence of a high number of dengue vector breeding habitats in school premises. However, documented studies on the entomological risk in school premises are limited. Therefore, the objective of the present study was to investigate the abundance of dengue vector and their probable breeding habitats within school premises. A cross sectional study was conducted in 60 randomly selected schools in four educational zones namely Gampaha, Minuwangoda, Kelaniya and Negombo, comprising 15 schools from each zone. Entomological surveys were conducted at each selected school for seven months (June-December, 2016) using stranded dipping and siphoning methods depending on the nature of the breeding habitat. Identified breeding habitats were recorded and categorized into major habitat types. The data were recorded as I & II, III & IV instar and pupae. Larval stages of III & IV instar were directly identified, while I & II instars were reared up to III instar at confined cages supplemented with larval feeding and identified to the species level. Pupal stages were also reared separately in adult rearing cages and the species identity was confirmed through adult morphology. Morphological identifications confirm *Ae. albopictus* as the most predominant vector species in school premises (92.86%; n=26) belonging to all four educational zones, and *Ae. aegypti* was identified only from 2 schools (7.14%; n=02) in the Negombo educational zone. A total of 12 mosquito breeding site categories were identified at school premises namely leaf axils, tree holes, decaying materials, coconut shells, plastic containers, clay containers, metal containers, flower pots, tyres, tyre prints, drains, blocked toilets. Almost all schools had an average of 10 types of probable breeding habitats. The majority of containers were dry (81.51%; n=7,156) and some were wet containers. Out of 1623 wet containers, 41 infected larval containers were found from 28 school premises of which 12 are natural (29.26%) and 29 are artificial (70.73%). Prolific breeding of *Ae. albopictus* was observed in clay pots. Since the majority of breeding habitats were of anthropogenic origin, it is very important to introduce and practice "reduce, reuse, and recycle" for solid wastes (3R concept). Dengue prevention committees should be established in the schools for close supervision.

Keywords: Dengue vector, breeding habitats, School premises.

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908/B

Review of close loop heat pump dryers for food drying

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Sri Lanka has experienced an increase in the number of different dryers for commercial food dehydration. The objective of this study was to review the overall performance of heat pump dryers (HPD), and to survey and test the performance of locally introduced HPD for end user recommendation and improvements. We reviewed studies on heat pump drying and compared the methods therein with the most common methods of drying in overseas food drying industries, and in Sri Lanka. In a closed loop HPD, the heat pump retrieves the heat in the exhausted air to heat the air entering the dryer, while it removes the moisture in the exhausted air; it delivers more heat than the work input to the compressor and achieves high energy efficiency. The system has the optional ability to dry thermally sensitive food materials at near ambient temperature by configuration of the compressor capacity, and drying under an Oxygen free environment by using inert gas, thus under aseptic processing by air filtering, and sterilizing the drying chamber with the load before operating the dryer using the correct dosage of Ozone gas. Results of comparison of HPD with the most common traditional drying methods for food drying and survey based results obtain using 10 closed type heat pump dryers operating in Sri Lanka for fruits, vegetables, coconut and tea showed that heat pump dryer is better than traditional hot air drying methods. A closed type heat pump dryer experimentally investigated for mushroom, jackfruit, pineapple, banana, papaya, curry leaf, pepper, and cloves showed significance quality and operational cost improvement compared to kerosene oil and electrical hot air dehydration, and was competitive with vacuum drying and freeze drying for overall performance. Incorporation of this technically feasible and environment friendly HPD into dehydrated food value and supply chain in Sri Lanka is recommended with policy support, as the technology is less understood and there is further improvement avenues of the system to obtain overall benefits for the end users.

Key words: drying system, energy recovery, closed loop heat pump dryer.

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909/B

Isolation and identification of soil micro fungi of semi natural montane forest and adjacent pine plantation in Peacock Hill, Pussellawa, NuwaraEliya district

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Soil microbial community structures and functions are the most rapidly responding biotic component of any terrestrial habitat. Soil micro flora and soil physicochemical properties were affected by the establishment of mono cultures such as *Pinus* spp. and *Eucalyptus* spp. In Sri Lanka there is little published literature on investigations of these changes due to the habitat destruction. Therefore the present study was carried out in an attempt to identify and compare the soil fungal diversity and potential decomposing ability of the soils of a *Pinus* plantation and the adjacent, semi natural montane forest in Peacock hill, in Pussellawa. Soil samples (15 replicate samples) were collected following stratified random sampling from three sub sites of areas 10m×15m. Comparative studies of fungi in each sample were carried out following the soil plate method. Pure substrates (starch, pectin, cellulose and lignin) were used to test the potential decomposing abilities and metabolic capacities of the fungi with more than 30% of frequency. Results showed that significantly higher fungal diversity in semi natural montane forest (32 different fungal spp.) than in the *Pinus* plantation (9 different fungal spp.) *Trichoderma* spp., *Mortierella* spp., *Penicillium* spp., *Acremonium* spp., *Aspergillus* spp., *Rhizopus* spp. and white sterile spp. were isolated at higher frequencies from semi natural montane forest. Frequently isolated fungal species from the *Pinus* plantation were *Mortierella* spp. and Dark sterile spp. *Penicillium* spp. and *Trichoderma viride* were common to both sites. Fungi isolated from both sites showed versatile abilities in utilization of many substrates such as starch, cellulose, lignin and pectin. The present study showed significantly negative impacts from exotic *Pinus* plantation on fungal community structure in the particular sites.

Keywords: Fungi, monoculture, semi natural montane forest soil, *Trichoderma* spp.

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910/B

Variation of phytochemicals and antioxidant capacity with the maturity of pods and different parts of *Moringa oleifera* Lam.(Moringaceae)

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Moringa oleifera Lam. is a multipurpose, industrially important, medicinal plant belonging to the family Moringaceae. Due to lack of information on variation of phytochemicals with pod maturity and their distribution in different parts, the present study was undertaken to investigate the phytochemical content at different maturity stages of the pods and different parts of the plant.

Different plant parts *viz.* leaf, flower, bark, stem, root and different maturity stages of pods were collected from *M. oleifera* in the Western Province of Sri Lanka, and air-dried, powdered samples of each plant parts were prepared. Phytochemicals were extracted using 80% methanol. The total phenolic content (TPC) and total antioxidant capacity (TAC) were determined using the modified Folin-Ciocalteu colorimetric method and ferric reducing antioxidant power (FRAP) assay respectively. Statistical comparison of the mean values of three replicates was performed by the General Linear Model (GLM) of ANOVA followed by Turkey Multiple Range Test using SAS.

The present study revealed that the tested phytochemicals and antioxidant capacity are distributed in different parts and all maturity stages of the pods of *M. oleifera*. A significantly higher TAC and TPC were found in flowers. The order of increasing concentration in different parts of *M. oleifera* was flower>leaf >root > bark>stem, whereas that in different maturity stages of pods was immature> 50% mature>75% mature>fully mature. A positive correlation ($R^2 = 0.94$, $p < 0.001$) between phenolic compounds and antioxidant activities of *M. oleifera* extracts was observed. Different plant parts of *M. oleifera* reveal strong antioxidant activity and could serve as potential source of natural antioxidants to food and health industries.

Keywords: Antioxidant capacity, Flavonoids, *Moringa oleifera*, Moringaceae, Phenolics, Plant parts.

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911/B

Effect of different spacing fertilizer treatments on physical and chemical yield of different plant parts of *Pogostemon heyneanus* Benth.

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Pogostemon heyneanus Benth. (Lamiaceae) is an aromatic, industrial crop, widely cultivated in many Asian countries for its distinguished fragrance and other therapeutic purposes. The present study was undertaken to determine the effect of different spacing and fertilizer treatments on physical and chemical yield (total antioxidant capacity (TAC), total phenol content (TPC) and total flavonoid content (TFC)) of different parts (leaf, stem, and root) of *Pogostemon heyneanus*. Nine treatment combinations consisting of three levels of space (S1: 90cm×45cm, S2: 90cm×60cm and S3: 90cm×90cm) and three type of fertilizer treatments (F1: Organic, F2: Inorganic, and F3: Control) were used for the field experiment in a completely randomized block design with three replicates. The plant growth parameters such as height, canopy spread, number of leaves, number of branches, and length of branches were recorded at two weeks intervals. The fresh weight and the dry weight of leaves, stems and roots of uprooted plants were recorded in each month. TPC, TFC and TAC of leaf, stem, and root were determined by the colorimetric Folin-Ciocalteu method, Aluminium Nitrate method and Ferric Reducing Antioxidant Power (FRAP) assay, respectively. The highest number of leaves (928±6.2), leaf area (9484±4.9cm²), leaf fresh weight (516.2±4.9g), leaf dry weight (70.3±0.7g), TAC (56.7±0.43 (mg TE/ g DW)), TPC (11.6± 0.25 mg/GAE/gDW), and TFC (86.1±2.83mg/RE/g DW) were observed in treatment combination S3F1. The order of increasing TPC, TFC and TAC of *P. heyneanus* was leaf > root > stem. Therefore, it can be suggested to use 90cm×90cm level of spacing (S3) and organic fertilizer (Compost) (F1) to cultivate *P. heyneanus* plants on a commercial scale. The presence of a higher amount of dry matter content and chemical yield (TPC, TFC and TAC) in the leaves indicated the usage of leaves for the development of effective drugs, instead of roots and stem.

Key words: Growth parameters *Pogostemon heyneanus*, total antioxidant capacity, total phenol and flavonoid content.

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912/B

**Small scale poultry farming related constraints in Panduwasnuwara divisional secretariat
division of Kurunegala district, Sri Lanka**

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Poultry is the most developed livestock sub sector in Sri Lanka, and has shown a phenomenal growth over the past three decades. The highest number of the poultry farms in one district is located in the Kurunegala district (19,044). However, 74% of layer farms and 62% of broiler farms located in the district are small scale and rear fewer than 1000 chickens, and the existing business environment is not comfortable for small scale poultry farmers.

This study attempted to determine the constraints related to small scale poultry farming in the Panduwasnuwara divisional secretariat division of the Kurunegala district, where the largest number of poultry farms are clustered in a unit area. The study design was a qualitative one. The small scale poultry farmers in the area were the subjects of study and data were collected through an oral interview with randomly selected small scale farmers and stakeholders (n=103). Field survey and participant observation approach were also employed in the study. The saturation method was the guiding method. Data were analyzed through the framework analysis method.

Increasing cost of feed and equipment, hardness of water, lack of day old chicks, fluctuation of egg and poultry meat prices, no proper mechanism to preserve the excess production in low demand seasons, no adequate factories to produce value added products, a mafia of veterinary product companies and poultry feed producers, lack of veterinary services, low quality of the products due to excess usage of veterinary drugs, lack of micro financing facilities which can be beneficial for low income people to enter the industry, socio-cultural and religious issues, and legal constraints are identified as the problems faced by the small scale poultry farmers in the area.

Small poultry flocks managed by individual farm families led to obtaining food security, income and gainful employment for women and children. Therefore the government should take necessary steps to overcome the above-mentioned problems and it can be beneficial for socio-economic development of the country through developing the quality of life in low income households.

Key words: Agriculture, Domesticated fowl, Rural economy.

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913/B

The postharvest losses of vegetables through the normal transportation method in Sri Lanka

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Postharvest loss (PL) can be defined as the degradation, in both quality and quantity, of a food production from harvest to consumption. In a starving and increasing competitive world, reducing postharvest food losses is a major agricultural goal. In general, vegetables grown in different areas in Sri Lanka are packed in poly-sack bags, plastic trays, gunny bags, wooden boxes, cardboard boxes and woven sacks, and transported by lorries, open trucks, three wheelers, containers, tractors, canters, and motor bikes with no definite temperature and humidity. Thus, PL of vegetables ranges from 16-41% but data are not available on the losses of each vegetable through the normal transportation practices in Sri Lanka. In order to assess the PL of vegetables through the normal transportation methods, five types of vegetables, *viz.*, cabbage, carrot, tomato, leeks, and brinjal, were selected based on the highest extent of production and highest perishability. The losses were calculated for vegetables that come from NuwaraEliya to Pannala and Dambulla to Pannala via normal transportation methods. The mechanical damage percentage, physiological weight loss and Visual Quality Rating (VQR) of vegetables were measured at the loading and unloading stages of the selected nodes, namely Dambulla, Pannala, and NuwaraEliya. Results indicate that the mechanical damage percentages for cabbage, carrot, tomato, leeks, and brinjal were 14%, 12%, 8%, 11%, and 9% respectively, while the physiological weight losses were 1.41%, 2.44%, 2.34%, 2.11%, and 1.23% for the same, respectively. The highest VQR change is showed by leeks (3.00) followed by cabbage (2.73). Observation further showed that transporting vegetables via cold chain transportation by packing in plastic crates will be a solution to reduce the postharvest loss of vegetables during transportation.

Keywords: Postharvest loss of fruit and vegetables, visual quality rating, mechanical damage

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914/B

Application of Cleaner production for selected leeks and papaya value chains in Sri Lanka

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Agriculture plays vital role for the national economy while contributing 7.9% to the GDP while the fruit and vegetable sub sector of agriculture has contributed between 0.6-0.8% to the total GDP of Sri Lanka. Postharvest losses of the fruits and vegetables through the value chains impacts on food security and energy security of the country. It is estimated that in Sri Lanka, 30-40% of fruits and vegetables are wasted through the value chain. However, literature data is lacking on postharvest losses of each fruitor vegetable. Cleaner production (CP) is a continuous application of an environmental strategy to increase the productivity of processes, products, and services by ensuring less harm to the environment. In this study, CP methodology was used to assess the postharvest losses of leeks and papaya, and to identify the cleaner production potential. During this study, the material flow of leeks and papaya from Nuwara Eliya to Pannala and Puttalam to Pannala, via the Dambulla Economic Centre (DEC) was studied, in order to identify the postharvest losses and to identify the causes for the losses, and cleaner production potential to reduce or utilize the losses. At each node of the value chains, losses were calculated through analyzing the daily and monthly resource flow. Then the CP potential was calculated based on the cost of waste. It was found that 15% of leeks and 20% of papaya were lost in the value chain and the postharvest losses are high at the retail level. Further, results indicate that CP potential at the retail level of leeks and papaya were 4.3 Million LKR/year and 0.18 Million LKR/year respectively. The identified root causes for the losses were mechanical damage, poor handling, poor package, lack of demand, and climatic change. The CP solutions obtained through the study to reduce postharvest losses of leeks and papaya are providing of technological education for farmers on planting, harvesting, handling, and transportation, and the distribution of quality seeds. The usage of plastic crates and cold storage facilities could reduce much loss. Instead of discarding, wastage could be used to produce fuel, biogas, synthesized proteins, and copolymer substances.

Key words: Cleaner production, Postharvest losses, Fruits and vegetable value chain

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915/B

Assessing of fish freshness using Torrymeter, chemical, microbiological, and organoleptic methods in Skipjack tuna (*Katsuwonus pelamis*), Indian scad (*Decapterus russelli*), and Spangled emperor (*Lethrinus nebulosus*)

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Fish is a major protein source consumed by Sri Lankans. The best keeping quality or freshness of fish retains the nutritional quality of fish, and it is essential as a marketing tool. The freshness of fish can be determined by microbiological, chemical, organoleptic, and rapid sensing instrumental methods. Torrymeter is a sensor tool that can measure fish freshness quickly. In order to validate the Torrymeter for use as a quick, easy, and non-destructive method of freshness determination for Skipjack tuna (*Katsuwonus pelamis*), Indian scad (*Decapterus russelli*) and Spangled emperor (*Lethrinus nebulosus*), fish were kept in chilled conditions for seven days, and assessed by Total plate count (TPC), Total Volatile Base Nitrogen test (TVB-N), Organoleptic Quality Index Method (OQIM) evaluations, and the obtained data were compared. Chi-square test of Analysis of variance indicated that Spangled emperor showed a correlation coefficient with TPC, TVBN, and OQIM in 86%, 86% and 86% equality with Torrymeter, respectively. In Indian scad it was obtained as 86% (TPC), 96% (TVBN) and 86% (OQIM) respectively. However, Skipjack tuna showed poor correlation that corresponds with 1% (TPC), 2.4% (TVBN) and 3% (OQIM) with Torrymeter values due to the fish obtained from multiday boats, in which initial freshness of the fishes are very low. The results indicate that use of the Torrymeter as a quick, easy, and non-destructive method for freshness determination of Indian scad and Spangled emperor can be done in Sri Lankan fishing industry.

Key words: Fish freshness; OQIM; Torrymeter; Indian scad, Spangled emperor

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916/B

Comparison of water quality and primary productivity between shrimp and seabass culture ponds.

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Since shrimp culture is affected by various diseases, farmers are faced with heavy economic losses. Therefore some farmers have tried to introduce species diversification. Sea bass is a brackish water fish found living in the natural environment of the Northwestern province and is a potential replacement to shrimp as this species too has an export market. Some farmers are trying to culture seabass in abandoned shrimp ponds. One farmer was culturing both species. The present study investigates the water quality of both culture species and the primary productivity in the ponds.

The water quality and chlorophyll content was monitored for 16 weeks during the shrimp culture period. Water exchange was 30% of the total volume weekly for both species. And both species were provided artificial feed. Shrimp ponds were regularly treated with probiotics for water management, while fish ponds did not receive this treatment. All ponds were aerated.

Salinity(fish: 14.37 ± 3.88 ppt and shrimp: 14.25 ± 3.73 ppt), pH, (fish: 8.20 ± 0.35 and shrimp: 8.14 ± 0.25),temperature(fish and shrimp: $28 \pm 1.5^{\circ}\text{C}$), dissolved oxygen(fish: 4.99 ± 0.54 mg/l and shrimp: 4.86 ± 0.15 mg/l), total suspended solids(fish: 125 ± 10.22 mg/ l and shrimp: 122.38 ± 14.35 mg/l), phosphate(fish: 0.34 ± 0.24 mg/l and shrimp: 0.39 ± 0.23 mg/l), and nitrate(fish: 1.50 ± 0.46 mg/l and shrimp: 1.37 ± 0.47 mg/l) did not show a significant difference between the culture ponds for the two different species. However,there was a significant difference between ammonia, (0.11 ± 0.04 mg/l for fish and 0.062 ± 0.02 mg/l for shrimp), nitrite(0.14 ± 0.02 mg/l for fish and 0.02 ± 0.08 mg/l for shrimp), and chlorophyll (14.3 ± 3.2 $\mu\text{g/l}$ for fish and 11.9 ± 3.3 $\mu\text{g/l}$ for shrimp) for the 2 different culture species ($p < 0.05$). The phytoplankton density was also significantly higher in fish ponds but the zooplankton density was higher in shrimp ponds and did not show a significant difference statistically. The ammonia and nitrite content in the fish ponds were higher than shrimp ponds, most probably because probiotics helped controlling the ammonia and nitrite in shrimp ponds. Since the water is pretreated before entering shrimp ponds it takes more time for developing algae and that again is controlled by the probiotics used, as nutrient circulation is controlled. But in fish ponds no probiotics were used and therefore the algal content was higher, with more chlorophyll. All water quality parameters monitored were within acceptable limits for brackish water species, but the total suspended matter content remained at a high level for both species. It was concluded that since shrimp ponds operate under controlled conditions compared to the fish ponds, productivity of shrimp ponds was controlled by these additives. Therefore the natural primary productivity was higher in fish ponds than shrimp ponds.

Key words: Plankton productivity, Shrimp culture, Seabass fish culture, pond water quality

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917/B

Extraction, characterization of chitosan from *Portunus pelagicus*, and comparison with commercial chitosan

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Chitosan is a polyaminosaccharide obtained by the deacetylation of chitin which is the second most abundant natural polysaccharide found in crustacean shells. Since the biodegradation of chitin is very low, accumulation of shellfish discards has become a major concern in the seafood processing industry in Sri Lanka. Also chitosan has been of interest in the past few decades, due to its potential broad range of food industrial applications as edible films, antimicrobial agents, preservative agents, acidification and clarification agents, etc. However only limited attention has been paid to bakery industry applications of these versatile biopolymers. So utilization of chitosan as an additive for crackers is important due to its health benefits. A study is carried out to investigate the extraction and characterization of chitosan from crab species *Portunus pelagicus* using the conventional methods deproteinization, demineralization, decolorization and deacetylation. The extracted chitosan is evaluated for its physiochemical and functional properties, compared to commercial chitosan.

Moisture ($0.91 \pm 0.02\%$), protein ($9.88 \pm 0.07\%$), and ash ($1.72 \pm 0.29\%$) content is higher in extracted chitosan, while there is no significant difference in fat ($0.08 \pm 0.001\%$). The degree of deacetylation (65%) is lower than the commercial chitosan (85%). The bulk density (untapped) is higher in extracted chitosan (0.17gmL^{-1}) while water binding capacity ($617.3 \pm 46.5\%$) and fat binding capacity ($367 \pm 29\%$) are low. Viscosity (148 ± 4 Cp), average molecular weight (180 kDa), and solubility ($76.93 \pm 8.79\%$) are lower in extracted chitosan than commercial chitosan. Results revealed that chitosan can be extracted from crab shells with about 15% yield, using the chemical method, and the extracted chitosan has properties in the range values in literature although it has some deviations from the commercial chitosan.

Key words: Chitosan, Crab shells, Properties.

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918/B

**Development of crackers supplemented with Chitosan extracted from
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Chitosan has been of interest in the past few decades due to its potential broad range of food industrial applications as edible films, antimicrobial agents, preservative agents, acidification and clarification agents. However only limited attention has been paid to bakery industry applications of these versatile biopolymers. So utilization of by-products of seafood processing industry for the development of crackers is of utmost important due to their health benefits. So use of chitosan as a food additive was evaluated. Crackers were prepared with incorporation of levels of chitosan of 5%, 10%, 15% and 20%. Sensory evaluation was conducted using 30 untrained sensory panelists to select the best proportion that could be incorporated using six attributes, viz., appearance, color, odor, crispiness, hardness, taste and overall acceptability, with the four supplemented samples and the control. Water activity, microbial counts, and moisture content of the samples were measured weekly to determine the shelf life of the crackers. Laboratory sensory evaluation showed that overall acceptability of the four samples were 3.28, 3.63, 2.32, 2.15 respectively. 10% Chitosan gave the best quality crackers in terms of taste, crispiness and appearance with compared to the control. It has the mean rank for the attributes appearance (3.23), color (3.52), odor (3.38), crispiness (3.63), hardness (3.37), and taste (3.33). The moisture content was slightly increased after the third week of storage, but all values were below 15%. The water activity values of all samples also remained below 0.6. These results show that chitosan can be incorporated into a cracker at a level of more than 5% and closer to 10%.

Key words : Chitosan, Crab shells , Crackers, Sensory evaluation

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919/B

Performance Evaluation of a Newly Fabricated Steam Distillation Unit on Extracting Essential Oil from *Pogostemon heyneanus* Benth. (Lamiaceae)

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Pogostemon heyneanus Benth. (Lamiaceae) is a large, straggling under shrub commercially grown to extract an essential oil called Patchouli. Because of low technical sophistication and infrastructure requirements, steam distillation has been popularized for extracting essential oil from aromatic plants. The Department of Plantation Management of the Faculty of Agriculture and Plantation Management of Wayamba University of Sri Lanka has developed a prototype steam distillation unit for extracting essential oil from *P. heyneanus*. The study was conducted to evaluate the steam distillation unit performance under three different particle sizes of dried herbage of *P. heyneanus*. The three treatments of the study were particles less than 5 mm (T1), in between 5 and 10 mm (T2) and larger than 10 mm (T3). The distillation unit was fully loaded with each particle size of dried leaves of *P. heyneanus* prior to the distillation. The oil recovery was measured at 10 minute intervals, until the total recovery reached an equilibrium. The pressure and temperature were maintained constant at $0.50 \pm 0.07 \text{ kg/cm}^2$ and $100 \pm 5^\circ\text{C}$, respectively. The total leaf used in T1, T2 and T3 were respectively 3038, 2300 and 2070 g. The respective packing densities of T1, T2, and T3 were 0.08, 0.06 and 0.05 gcm^{-3} . The final oil recovery of T1, T2, and T3 were respectively 34, 22, and 26.7 ml. The respective total effective distillation periods for T1, T2, and T3 were 120, 120 and 140 minutes. T1, T2, and T3 were able to recover respectively 85.3, 73.6 and 72.7 % of oil from the total recovery during the first hour of the distillation and also respectively 14.7, 26.4 and 27.3 % of oil from that of the total during the final 100 minutes of the distillation. The highest extraction efficiency was found in T3 (86%) while that of the lowest was found in T2 (63.8%). The reduced formation of free channels at the lowest packing density in T3 increased the leaf stem interface and recorded the highest oil extraction. Among the selected particle sizes, the best performance of the steam distillation unit in terms of oil recovery of *P. heyneanus* was found with the particles smaller than 5 mm. However, based on the extraction efficiency of the distillation process, the particles larger than 10 mm could be partially recommended as the best.

Keywords: *Pogostemon heyneanus*, Steam distillation, Particle.

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920/B

Quantification of selected prebiotics and prebiotic potential of local yams Gahala (*Colocasia esculenta*), Kiriala (*Xanthosomas agittifolium*), and Innala (*Plectranthus rotundifolius*)

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Locally available yam varieties in Sri Lanka are known to possess considerable dietary fiber, which may have a potential to act as prebiotics. Since some of the locally available yam varieties have been found to have prebiotic potential, the need to evaluate such potential in other local yam varieties has been taken into consideration. In this research, three locally available yams, Gahala (*Colocasia esculenta*), Kiriala (*Xanthosomas agittifolium*), and Innala (*Plectranthus rotundifolius*) were evaluated for their prebiotic potential. It was done by determination of indigestible polysaccharide content, quantification of resistant starch, evaluation of gastric and intestinal digestion followed by *invitro* colonic fermentation, and investigating the effect of selected yams on probiotic growth.

Yams were obtained from local markets in Sri Lanka. Ethanol extraction was performed for fresh ground samples and acidic and enzymatic digestion was conducted using the dried extracts to quantify the indigestible polysaccharide. Resistant starch was determined through the resistant starch assay kit (Megazyme), which uses the AOAC official method 2002.02. Moreover gastric and intestinal digestion with dialysis followed by *in vitro* colonic fermentation was conducted and crude fiber, resistant starch, and total sugar contents were measured before and after the digestion/fermentation, to evaluate the effect of yams on the latter. Finally, the effect on probiotic growth was evaluated by obtaining the colony counts after inoculating *L. acidophilus* (New Zealand Dairies[®]) culture to de Man Rogosa and Sharp agar containing 3% (w/w) dried yam powder.

The indigestible polysaccharide content, per gram of dry extractm, for Gahala, Kiriala, and Innala, were 623.7 ±8.8 mg, 400.9 ±15.8 mg, and 448.7 ±17.0mg respectively. Resistant starch content was determined as a percentage of total starch content, and the yams contained 65.73±2.67%, 54.49±3.51%, and 37.82±9.14% respectively. The crude fiber content and resistant starch content were relatively similar before and after the gastric and intestinal digestion, proving that they were not digested and moved to colon for the fermentation. After colonic fermentation the total sugar content was reduced, suggesting that some compounds were fermented in colon, which is a main characteristic of a prebiotic. The *L. acidophilus* colonycounts were increased initially and then started to decline after a period of time, confirming that the yams do have a positive effect on probiotic growth. The series of experiments revealed that the local yams Gahala (*Colocasia esculenta*), Kiriala (*Xanthosomas agittifolium*), and Innala (*Plectranthus rotundifolius*) had considerable quantities of prebiotic compounds and have prebiotic potential.

Key words: Gahala, Kiriala, Innala, prebiotic potential.

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921/B

Diligent deliberations on the functions of the paddy milling Industry in Eastern province of Sri Lanka as to whether it is in boom or bust

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The SME sector of Sri Lanka is the backbone of the nation. It contributes to the development of the country on a massive scale while opening up avenues of employment for the community at large. SMEs also contribute to a remarkable extent to the GDP, around 52% according to statistics of Ministry of Industry and Commerce. There are plenty of avenues for the growth of SMEs in the nation. It is imperative therefore that research be done to enhance the performance and efficiency of the SME sector in Sri Lanka. With this assessment of SMEs in mind, the researchers have studied the functional aspects of the paddy milling industry in the Eastern Province, which is an important cog in the wheel of paddy production in the supply of rice, which is the staple diet of the masses.

Information was collected regarding paddy milling SMEs from the Department of Census and Statistics. A pretested structured questionnaire was administered to randomly selected paddy millers in the region. The data thus collected was compiled in a spreadsheet and subjected to data cleaning. The final data obtained were analysed by Ordinary Least-Square Regression (OLS) by employing the econometric software STATA 11. In order to avoid model specification, heteroscedasticity and multicollinearity errors in particular, and to ensure the normality the regression diagnostic estimation methods were performed by steps, which eliminated progressively the variables highly correlated to others in the model until a best linear unbiased estimate (BLUE) was obtained.

The results revealed that the experience of the entrepreneur ($p > |t| 0.001$), numbers of employees ($p > |t| 0.003$), access to credit ($p > |t| 0.024$), and running capital ($p > |t| 0.000$), showed a positive and statistically significant effect on the turn-over of the paddy milling SMEs in the Eastern Region of Sri Lanka. It is recommended that the activity which influenced the turn-over of the paddy milling industry positively be encouraged and fostered. With reference to the experience, an informal education extension program with special reference to supply chain management, better marketing practices and innovative value addition strategies could be extended to the paddy millers. Another option would be for either the Government or the employer to train unemployed youth in the paddy milling industry in the Eastern region and set them in employment in existing paddy mills. Besides, to attract more employees afresh and keep those who are already in the system, better payment and benefits have to be made. Finally, increased access to credit and running capital would certainly result in better performance of the paddy milling industry in Eastern province of Sri Lanka.

Keywords: Small and medium scale paddy milling enterprises, Ordinary Least-square, Eastern province of Sri Lanka

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922/C

Long-term trends of temperature in Sri Lanka

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Even though temperature variation in Sri Lanka is in a narrow range, being an island it is vulnerable to the changes happening in the global climate. In this paper, long-term trends in averages and extremes of Sri Lankan temperature were studied. The temperature data analysed consist of 55 years of daily raw maximum and minimum temperature records from 20 stations scattered throughout the island. The non-parametric Mann-Kendall and Sen-Theil methods were used for the investigation. The pre-whitening method was used to remove autocorrelation from the time series. To test the data with seasons, the modified seasonal Mann-Kendall trend test was applied. Results show a general increase in the maximum (T_{max}) and average temperature (T_{ave}) for most of the stations island-wide and a few stations showed an increasing trend in T_{min} . The T_{ave} was significantly increased for a majority of the stations in Sri Lanka during most of the months, especially the month of July, during which the greatest number of stations showed an increase in T_{ave} . Although it is difficult to give reasons for such an increase, deforestation in recent decades may be responsible, together with the global climate change, for the overall increase in the temperature of Sri Lanka. A regional trend attribution study is suggested as a window for future research.

Keywords: averages, extremes, non parametrics, trend analysis.

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923/C

E-waste management practices: flea market as a stimulator to promote reuse and recycling of used computers and mobile phones

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The increasing demand for Information and Communication Technology and the rapid turn-over in technology is creating a growing e-waste stream all over the world. It is an issue driven by the rapidly increasing quantities, the hazards involved with disposal, and the valuable materials in it. In Sri Lanka too, use of computers and mobile phones are increasing and the disposal of waste will be a huge issue in future. Therefore it is very important to carry out studies to investigate the possibility of reuse e-waste through flea market. The purpose of this research is to investigate the feasibility of flea markets as a strategy for e-waste reuse in the Kandy Municipal Council, with special attention on used computers and mobile phones. Data collection was done through two questionnaire surveys: Questionnaire I to find out stakeholders' and people's perception on electronic items, disposal practices of e-waste, and reuse through the flea market strategy, and Questionnaire II to evaluate efficacy of the flea market as a strategy for e-waste management. The outcome of the study showed that one third of the consumers were not aware of the term e-waste, or the health risks and environmental threats associated with it. Nearly one third of the population buy used computers and mobile phones. People use PCs for nearly 05 years and mobile phones for 03 years. The majority (81.3%) do not dispose of e-waste, but 53% stored e-waste at home. 40% Considered consumers are responsible for e-waste management rather than government or producers. 59% Were unaware of authorized collectors fore-waste. Feedback from awareness program indicated 100% awareness of e-waste and its impacts. 65% Did not consider used electronics to be waste. 82.5% Were willing to direct their e-waste to flea markets. The efficacy of the flea market was assessed and found to be successful as an appropriate strategy for e-waste management. It is important to implement awareness programs to increase consumers' knowledge on e-waste and to conduct flea markets for reuse of e-waste.

Keywords: Flea market, KMC, E-waste, Reuse, Computers, Mobile phones.

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924/C

**Timing correction of Frequency Demodulation of an FM signal by Zero Crossing detection
by digital signal processing**

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The Information signal of a frequency modulated (FM) signal can be recovered by detecting zero crossings (ZC) of the FM signal. Digital low pass filters which work with regular sample intervals cannot be used to recover the original message directly because ZCs occur at irregular intervals. Unknown sample values with regular intervals can be obtained by interpolating with high sampling rate. Lagrange interpolation can be used to find an unknown point which connects as a polynomial curve between known numbers of points of a plot. Generally, the three points Lagrange interpolation method cannot be used to find up sample values between real time moving zero crossing points by hardware implemented Digital Signal Processing (DSP) blocks, because mathematically it needs both last and next zero crossing point values. These type of DSP blocks can be implemented by using software defined blocks with keeping signal history and counting in both backward and forward directions. The three points $(x_2, f(x_2)), (x_1, f(x_1))$ and $(x_0, f(x_0))$ Lagrange interpolation method is used in the proposed method to find amplitude of up sampled signal between consecutive ZC points. Smooth polynomial interpolated signal values can be obtained in real time with inserting interpolated energy levels by using Lagrange interpolation.

This method finds interpolation points only within the zero crossing signals between $(x_2, f(x_2))$ and $(x_1, f(x_1))$. FM demodulator has three software signal processing blocks; the first and second blocks are connected in parallel. The input is connected to both these blocks simultaneously and outputs of these two blocks are connected to the third signal processing block for calculating the interpolated signal values. The first block passes the up sampled zero crossing signals and the second block calculates the x_2 and $f(x_2)$. The second block has two counters to count zero crossing signal length and they start the count from the end to the beginning, until they find the zero crossing signal. Outputs of the implemented FM demodulator are significantly different from the expected output. The difference may be due to incorrect calculations when changing frequencies of zero crossing points.

Key words: FM, Zero crossing, DSP, Software Defined Radio, Lagrange Interpolation.

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925/C

A supercapacitor-battery hybrid converter for PV solar powered lighting systems in Sri Lanka

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DC power applications assure significant improvements in overall efficiency with reduction of cost, particularly when energizing the systems with renewable energy sources. In recent years, photovoltaic (PV) solar-based power generation made a revolutionary change in conventional electrical power usage in Sri Lanka. Due to the fluctuating nature of renewable resources, energy storage and voltage regulation are essential for reliable power supply, specifically for standalone applications. To harvest the maximum energy produced by PV panels, efficient storage systems capable of fast charging are required. At present, batteries are the commonly used storage systems in Sri Lanka, with no fast charging capability. This paper presents a study into the possibility of applying a supercapacitor-battery hybrid technique for standalone PV solar-based systems in Sri Lanka. The hybrid technique is used (i) to improve the voltage conversion efficiency and (ii) to optimize energy yield from the PV system.

Supercapacitor (SC) is achieved by depositing activated carbon on electrodes to create a highly distributed porous material in contact with an electrolyte, resulting in an extremely large surface area. Single-cell SCs are available from 0.1 to 5000F. The energy density of a SC is about 1000 times larger than a standard electrolytic capacitor, and the power density is about 10 times larger than electrochemical batteries. The equivalent-series-resistance of a typical SC is in the milliohm range, $\sim 0.3\text{m}\Omega$ to few hundreds of milliohms. Thus, the voltage change across the terminals of a SC provides an effective loss-free *voltage dropping* function in a new DC-DC converter design. This SC-based DC-DC converter is low noise, free of electromagnetic interference issues, and is less complex compared to other high-frequency converter designs. The converter can achieve end-to-end efficiencies from 83 to 90%, and can be used in a variety of electronic applications, which require voltage to step-down.

Key words: supercapacitors, DC-DC converters, efficiency.

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926/C

Factors to consider in proper management of Human Resource for an Aircraft Maintenance Organization

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In the corporate world the proper management of human resources is a crucial factor with respect to other organizational aspects. Apart from the other industries, the aviation industry depends on the proper base construction of human factors. In every industry as well as organizations, proper human resource management builds the path towards success. Human resources are the hardest resources to handle in any industry, due to its continuous changing nature. In order to reduce the cost of each task done by human resources, there should be an optimal Human Resource plan, which is neither merely profit biased nor product biased. In most Approved Maintenance Organizations it is a growing problem to create the best Human Resource plan for all tasks, which it encounters in doing maintenance.

This research is expected to identify the direct and indirect factors that most commonly affect human resource planning, and build the most effective Human Resource planning method by selecting the most crucial Human Factor that needs major changes to improve its effectiveness. Literature will be provided in finding suitable areas of human factors to develop. This will gather the pros of each model and build the optimal to an Approved Maintenance Organization with the least cost.

The aviation industry is a rapidly growing industry in which the human factor is a deviation from normal human resource management of other industries. Most of the errors which occur are based on human errors rather than machine or component errors. The prime target of this research being understanding the crucial factors that have a direct effect towards managing human resources, the findings have been developed up to a point of providing enhancements. According to the findings and enhancements, suggestions are provided for implementation in a Maintenance Organization, and the assumed outcomes provided with the respective insights on to how and when the implementations are required.

Key Words: Human Factors, Human Fatigue, Aircraft maintenance organizations.

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927/D

**Assessment of drinking water quality of domestic wells in Chunnakam and Vadamaradchi,
Jaffna peninsula**

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An assessment of the quality of drinking water was carried out by measuring 12 selected physico-chemical parameters for selected domestic wells in Chunnakam and Vadamaradchi areas of Jaffna. Vadamaradchi is used as the reference site, as this area is considered to have the best fresh water in Jaffna peninsula. The measured physico-chemical parameters of water from selected domestic wells were compared with the standards established by World Health Organisation (WHO) and Sri Lanka Standards Institution (SLSI) for drinking water. Spatial and temporal variation of parameters among sites was analysed using Two-way ANOVA. The characteristic water quality parameters of the sampling sites were identified using Principal Component Analysis (PCA). Significantly high concentrations of nitrate and oil & grease were recorded in Chunnakam ($p < 0.05$), whereas significantly high dissolved oxygen (DO) and pH were recorded in Vadamaradchi. Nitrate concentration of the wells ranged between 0.021 – 40.1 mg/L, while 30% of these wells exceeded WHO permitted nitrate standard level, 11mg/L. Oil & grease (OG) of the wells ranged from 0.011 to 0.373mg/L, while 70% of wells in Chunnakam exceeded the SLSI permitted standard limit for OG, 0.2mg/L. A significant temporal variation of DO, total solids and total hardness was recorded in Chunnakam, while pH, DO and total phosphorus showed significant ($p < 0.05$) temporal variations in Vadamaradchi. The wells in Vadamaradchi were characterized by high DO, low nitrate, and low OG, while the wells in Chunnakam were characterized by high nitrate and OG. The values recorded in the current study can serve as baseline values for future water quality monitoring and management studies in Chunnakam and Vadamaradchi.

Keywords: Limestone aquifer, Contamination, Crude oil, Potability, Fertilizers

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928/D

Antimicrobial peptides in web silk of *Nephilengys malabarensis* (hermit spider) are secreted by the aggregate gland

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Increasing prevalence of infections caused by multidrug-resistant bacteria has become a global health issue due to the shortage of novel classes of antibiotics. The current study was conducted to assess the antibacterial activity of web silk secreted by *Nephilengys malabarensis*, the hermit spider. Natural silk, spun silk, and silk gland secretions were screened for antibacterial activity against gram positive *Staphylococcus aureus* and *Bacillus subtilis*, and gram negative *Escherichia coli* and *Pseudomonas aeruginosa* bacterial species. Natural silk was obtained directly from the web and spun silk was taken through artificial forced spinning. All silk samples and homogenized gland secretions were tested under the agar disc method and resazurin assay for antibacterial activity. Tetracycline was used as the positive control and saline as the negative control. All assays were repeated with a minimum of N=9. Data were analyzed with statistically significant values defined as $p < 0.05$ based on one-way analysis of variance (ANOVA) using SPSS statistics 20. The study revealed a significant inhibition of bacterial growth by the aggregate gland ($f = 18.46$, $p = 0.000$). The mean difference between positive control (Tetracycline) and the aggregate gland secretion was significantly similar at the 95% confidence level ($p = 1.000$). The extractions were resolved via SDS-PAGE and an agar overlay assay conducted. Further antibacterial activity was assayed after digestion with proteinase K. The inhibition zones present on the agar overlay plate and loss of activity after proteinase K treatment indicate that the active agent is a non-diffusible protein. Therefore, the results obtained strongly suggest that the peptides derived from *Nephilengys malabarensis* silk glands have antibiotic properties, which can be further investigated as antibacterial drug leads.

Keywords: multidrug-resistant bacteria, antibacterial activity, silk glands, agar overlay assay

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929/D

***In silico* identification of potential TALEN and CRISPR/Cas9 targets in Hepatitis B viral genome: A predictive approach for the treatment of viral infection.**

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Hepatitis B virus (HBV) is a potential viral pathogen of humans and cause chronic infection leading to several health problems such as chronic hepatitis, cirrhosis, and several types of liver cancers. Although the pathogen causes severe health issues, a treatment method to cure the disease is not developed yet and medications are available only to suppress the disease. But there is potential to use the modern gene editing techniques on HBV to eliminate the infection from the human body and several researchers have successfully tested the techniques on the virus. In this research, we selected the *HBx* gene which is responsible for the protein X, to identify potential Transcription Activator-Like Effector Nuclease (TALEN) and Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)Associated Protein9 (CRISPR/Cas9) target sites. The gene could thus be mutated, leading to the mutated protein, which might lack the original function. The reason behind the selection of gene *HBx* is that the protein X is involved in the reproduction and persistence of the virus and persistence is the reason for the above-mentioned health problems. Other than that, protein X interacts with many other human proteins, and this interactome was observed, and is available in the tool 'virusmentha'. The TALEN target sites of the gene were identified using the tool 'TALEN targeter' of 'TAL effector nucleotide targeter 2.0'. Several TALEN sites with maximum binding specificity were selected and analyzed for off-target bindings in human genome and for unnecessary bindings of the same viral genome using the tool 'Paired target finder' of 'TAL effector nucleotide targeter 2.0'. Further, the off-target bindings in the human genome was tested using the tool 'PROGNOS' and several TALEN sites for each of eight genotypes of HBV with highest binding affinity and minimal off-target effect were identified. Apart from that some CRISPR/Cas9 target sites, which are common to all the genotypes of the virus, were identified and analyzed for their off-target effect using the tool 'CC-Top'. But for CRISPR/Cas9 many possible off-target bindings in human genome were identified. So TALENs are probably more suitable than CRISPR/Cas9 nucleases for the editing of *HBx* gene. These identified TALEN sites and respective TALENs have the potential to be used as a treatment strategy for HBV but the on-target and off-target effects should be assessed further by *in vitro* and *in vivo* studies.

Keywords: Hepatitis B virus, *HBx* gene, TALEN, CRISPR/Cas9, Bioinformatics

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930/D

**Assessment of Potential Cytotoxicity of Selected Henna Based Commercial Hair Dyes Using
*Allium cepa***

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Henna is a dye mainly prepared from the plant, *Lawsonia inermis*. Henna based hair dyes are considered as less toxic in comparison to artificial hair dyes. However, scientific evidenceregarding the toxicity of hair dyes is meager. The present study was conducted to assess potential cytotoxicity of three selected henna based commercial hair dyes ("Black henna" Dye 1, Dye 2 and Dye 3) using the established toxicity test model, *Allium cepa* (common onion). Pre-germinated *A. cepa* bulbs were exposed to a range of dye concentrations (0.01, 0.05, 0.1, 0.3, 0.5 and 1.0 g/L) and mineral water (control) for 48 hours (n=10 bulbs per concentration) following standard protocols and transferred to the dye free mineral water for 72 hours for recovery. Cytotoxicity was assessed using multiple end points, viz., root growth, mitotic index, mitotic phase index, and nuclear abnormality occurrence in the root meristem of the dye exposed groups compared to the controls. The results revealed that the *A. cepa* bulbs exposed to the hair dyes showed significant root growth retardation, mitosis suppression and alterations in mitotic phase indices compared with the control ($p < 0.05$), in a concentration dependent manner, indicating cytotoxicity. Occurrence of condensed nuclei in the dye exposed *A. cepa* root cells was the highest nuclear abnormality (>90%) found in both 48 hour exposure and 72 hour post exposure stages indicating the onset of the cell death process. Based on toxicity threshold values for different end points, three dyes can be ranked in the order of decreasing cytotoxicity as Dye 1 > Dye 2 = Dye 3 (root growth inhibition) or Dye 2 > Dye 1 = Dye 3 (mitosis suppression) and Dye 3 > Dye 2 > Dye 1 (total nuclear abnormality induction). As the three tested hair dyes induced cytotoxic effects on the standard test model, *A. cepa* further toxicity assessments are warranted considering human and ecosystem health.

Keywords: *Allium cepa*, bioassay, cytotoxicity, Henna hair dyes

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931/D

Floral phenology and pollination success in the interspecific hybrid of *Momordica dioica* × *Momordica subangulata*

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Momordica dioica (S:Thumba Karavila) is a popular vegetable. It is dioecious and obligatory cross-pollinated. However, natural cross pollination is poor resulting in low yields. Recently, the Department of Agriculture introduced two interspecific hybrids of *M. dioica* × *M. subangulata*, named Chandu (female) and Vishma (male), for cultivation. Although the hybrids perform better than the traditional varieties they still require hand pollination for fruit set. The study was a preliminary investigation to understand the floral phenology and breeding behavior of the hybrids to identify barriers for natural cross pollination. Male (09) and female (12) hybrid plants initiated from cuttings were obtained from Angunakolapelessa Research Center and raised in the University premises, Colombo from 2016.06.19 to 2017.01.06 for observations. Female plants took 56–63 days and male plants 56–105 days from planting to initiate flowering. Female plants reached peak flowering in 59 days while males took 105 days, indicating asynchrony in flowering between the two sexes. A female flower bud took 10 days (mean of 50) and a male 12-15 days (mean of 200) from visible initiation to flower opening. Male and female flowers started blooming at night, usually between 7.30 and 8.15pm. Female flowers took 2.0 - 2.5 hours and males 2.5 - 5.0 hours to fully open. Female flowers had a shorter life span and closed earlier in the following day (6.15–7.30am) than male flowers (9.00–11.15am). Although the overall male: female flower ratio was 17:5, in early stages of the crop there were fewer male flowers to provide pollen to a relatively large number of female flowers. Thus, it may be beneficial to start male plants earlier than female plants or use previously stored pollen to overcome restrictions in the pollen supply. Fruit set from natural open pollination was 5% whereas hand pollination was very successful (93%). Asynchrony in male and female flowering and the shorter life-span of female flower were identified as reasons for poor natural pollination. However, insect pollination may have potential because *Trigona iridipennis*, a common insect pollinator, was found to frequent male flowers and forage on pollen.

Keywords: Floral phenology, interspecific hybrids, *Momordica dioica*, *Momordica subangulata*, pollination.

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932/D

Development of a rapid DNA based detection method for *Leptospira interrogans* in environmental water samples

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Leptospirosis is a wide spread zoonotic disease in the world, with 1.03 million incidences and 58,900 deaths annually. More than 230 serovars classified into 31 serogroups of leptospire have been described up to date. *Leptospira interrogans* is a commonly found species, which is responsible for many disease outbreaks. Although the transmission of leptospire mostly occurs through environmental water contaminated with an infected host's urine, detection of pathogenic leptospire from environmental water is still challenging. This study aimed to develop a Polymerase Chain Reaction (PCR) based method for the rapid detection of *L.interrogans* from environmental water samples. The sample preparation procedure for DNA extraction was optimized. *L.interrogans* serovar Icterohemorrhagiae and *L.biflexa* serovar Patoc were used as pathogenic and saprophytic strains respectively. Hundred milliliters of each pathogenic and saprophytic *Leptospira* spp. spiked water samples (10^7 cells/mL) were used for the DNA extraction. Prepared samples were centrifuged at 5000 rpm for 30 minutes to pellet the cells. One milliliter of each concentrated cell suspension was used to extract DNA using QIAamp DNA minikit. Extracted DNA was amplified using PCR targeting the *LipL41* gene, which is found only in pathogenic leptospire. The amplicon of *LipL41* gene (249 bp) on 2% electrophoresis gel was observed only for *L.interrogans* while *L.biflexa* was negative. The limit of detection (LOD) of the developed method was tested using 10^2 - 10^6 *L.interrogans* cells/mL water samples, and it was found that LOD was 10^3 cells/mL. This method is rapid and inexpensive compared to the other detection method such as Culture and Microscopic Agglutination tests. The developed method can be used even with basic laboratory facilities. This method can be applied to the study of the distribution of *L.interrogans* in environmental water samples.

Key words: *Leptospira*, serovars, serogroups, *LipL 41* gene

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933/D

Management of Mealybug Wilt of Pineapple (*Ananas comosus*(L.) Merr.) using different fertilizer applications

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Mealybug wilt of pineapple is a serious problem for the pineapple industry worldwide. This disease is common in pineapple cultivations in Sri Lanka. Reddening of leaves, twisting of tips, and wilting of whole plants are the characteristic symptoms of the disease. It is caused by pineapple mealybug wilt associated virus (PMWaV), which is spread by mealybugs. Farmers in Sri Lanka use various kinds of fertilizers to suppress the disease.

The objective of this study was to determine different fertilizer applications, which could show any effect on managing mealybug wilt disease and to determine the best fertilizer/fertilizers that can be used to control the disease successfully. One hundred and five pineapple suckers (3 months old), infected with pineapple mealybug wilt associated virus, were planted in three rows. There were seven blocks in each row and each block consisted of five pineapple plants. One and a half months after planting, six different fertilizer treatments (Albert's solution, Baur Coconut fertilizer, Baur pineapple fertilizer, NPK mixture recommended by the Department of Agriculture, Green care Liquid fertilizer, and Rhizobacteria Bio fertilizer) were given. One treatment was given for one block and the treatments were randomized between blocks. Fertilizer applications were continued every two months for one year. Infected plants with no fertilizer added were used as the control.

All plants were indexed using a five-unit disease index scale, in order to evaluate the disease severity. All treated and control plants were tested for the presence of pineapple mealybug wilt associated virus by Indirect Enzyme-Linked Immunosorbent Assay (ELISA), using locally produced polyclonal antiserum. Growth parameters (number of leaves and leaf length) were also measured in all treated and control plants. The results showed that the disease severity was low in plants treated with Albert's solution throughout the experimental period. Although the plants treated with Baur coconut fertilizer showed a higher disease severity at the beginning, there was a sharp decrease in severity with time. Plants treated with Baur coconut fertilizer had the lowest virus titer, and the next lowest was observed in plants treated with Albert's solution. While the number of leaves were highest in plants treated with Baur coconut fertilizer, the greatest length of leaves were observed in plants treated with Albert's solution. Out of the fertilizers used, Albert's solution and Baur coconut fertilizer were the best fertilizers which can be used to control the mealybug wilt disease in pineapple.

Keywords: Mealybug wilt, pineapple, fertilizers, disease severity, growth parameters, enzyme-linked immunosorbent assay

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934/D

Oviposition Responses of *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae) to Five Types of Grass Infusions

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Mosquito species exhibit a remarkable diversity of oviposition responses that ensure eggs are deposited into microhabitats favorable for successful larval development and the emergence of the next mosquito generation. The present study showed that there is a significant difference in the attraction of grass species with respect to *Aedes aegypti* and *Aedes albopictus*, for oviposition. Ovitrap baited with grass infusions, viz., *Cymbopogon confertiflorus* (Maana), *Bambusa vulgaris* (Bamboo), *Imperata cylindrica* ("Iluk"), *Cymbopogon citratus* (Lemon grass, "sera"), and *Zea mays* (Corn, "Badairingu") were evaluated as oviposition attractants or stimulants for *Aedes* mosquitoes. These grass species were selected for the research due to their abundance in Sri Lanka. Aged tap water was used as the control and mated blood fed females of *Aedes* mosquitoes were used for all the experiments. Significantly higher oviposition was observed with *Bambusa vulgaris* for both *Aedes aegypti* (82.75 ± 2.81) and *Aedes albopictus* (110.94 ± 1.37) mosquitoes. Significantly lower oviposition was observed with *Cymbopogon citratus* for both *Aedes aegypti* (10.25 ± 0.78) and *Aedes albopictus* (27.94 ± 0.69). Moreover, the mean number of eggs deposited in ovitraps baited with infusion made from fresh mature leaves was higher compared with dried mature leaves for both *Aedes* species. Combined grass infusion made from most attractive and least attractive grass species, *Bambusa vulgaris* and *Cymbopogon citratus*, respectively, was less attractive than the infusions made from single grass species. The repellency in *Cymbopogon citratus* for the *Aedes* mosquitoes was reduced by *Bambusa vulgaris* (Bamboo). These results indicate that individual leaf species are important in determining the oviposition responses towards different leaf infusions. Identification of chemical composition and microbial inhabitants are crucial components for future research. A better understanding of the wide diversity of *Aedes* mosquito oviposition responses towards the grass infusions will allow the development of new and advanced surveillance and control programs.

Keywords: *Aedes aegypti*, *Aedes albopictus*, Dengue, Grass infusions, Oviposition

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935/D

Phytotoxicity assessment of Profenofos based commercial insecticide using *Allium cepa* bioassay

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Allium cepa bioassay is an efficient test system for the assessment of toxicity/ cytogenotoxicity of environmental contaminants including pesticides. The present study is aimed to assess phytotoxic effects of the Profenofos based commercial insecticide, Polycron Profenofos™ (PP™), using the *A. cepa* bioassay. *A. cepa* bulbs (n=5) were exposed to a range of concentrations (*viz.*, 0.5, 1, 3, 5, 10, 20, 30, 60, 90 mgL⁻¹) of PP and aged tap water (control) for 7 days, and the root growth inhibition assay was used to determine the general toxicity. A significant (P<0.05) root growth retardation (13.2% – 93.8%) was obtained in all exposure concentrations compared with the controls and the retardation was concentration dependent. The root growth based effective concentration 50 (EC₅₀) was 25.8 mgL⁻¹ as determined by the USEPA TRAP programme. Cytotoxic and genotoxic impacts of the insecticide was also assessed by exposing root tip cells of the *A. cepa* bulbs (n=5) to 25.8 mgL⁻¹ (EC₅₀) of PP™ for 48 hrs. A parallel negative (aged aerated tap water) and a positive (10 mgL⁻¹ K₂Cr₂O₇) control was used. Suppression of the mitotic index (MI) and the occurrence of nuclear abnormalities (NA) were considered as the end points for cytotoxicity whereas occurrence of total chromosomal abnormalities (CA), including both clastogenic and aneugenic abnormalities, together with the micronuclei (MN), were considered as the end points for genotoxicity. A significantly higher (P<0.05) suppression of MI (35%) and occurrences of NA (32%) was observed in the root tip cells of the *A. cepa* bulbs exposed to PP™ compared with the negative control, signifying higher cytotoxic potentials of the tested formulation. Further, a significantly higher occurrence (P<0.05) of total CA (30%) and MN (6.4%) was observed in the root tip cells exposed to PP in comparison with the controls, reflecting a higher potential to cause genotoxic effects. However, the MI suppression, occurrence of NA, CA, and MN in the root tip cells of the *A. cepa* bulbs exposed to PP™, was not significantly different from the positive control. This study provides scientific evidence for the higher potential of PP™ to pose considerable phytotoxic impacts on the exposed flora.

Keywords: *A. cepa* bioassay, Phytotoxicity, Profenofos

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936/ D

Isolation and morphological characterization of petroleum crude oil degrading fungi from contaminated site in Sri Lanka

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Intentional and unintentional release of hydrocarbon contaminants into the environment might pose a range of detrimental impacts on the exposed biota including humans. Bioremediation is a promising tool for decontaminating petroleum hydrocarbon contaminated environments. The objective of the present study was to isolate petroleum hydrocarbon degrading indigenous fungi from a chronically contaminated site. Sludge and water samples were collected aseptically from an area subjected to long term intermittent discharges of petroleum hydrocarbons. Aliquots from the collected samples were separately inoculated into Bushnell Haas minimal (BHMS) salt broth amended with 2% filter sterilized Murban light crude oil and incubated at 28^oC for 7 days in a rotary shaker at 130 rpm. Crude oil was used as the model petroleum hydrocarbon and sole source of carbon and energy. After five successive enrichment cycles, three pure cultures of fungal isolates were obtained. The isolated fungi were grown on both BH agar amended with crude oil and potato dextrose agar (PDA). The microscopic morphological characterization of the fungal isolates were carried out using lacto phenol cotton blue stain based on the macroscopic characteristics of the colonies grown on PDA. The three isolated fungi were identified as *Penicillium* spp. based on morphological observations under the microscope. Further, the colony diameters of the three isolates grown on BH agar after a 5 day incubation period showed no significant differences ($p>0.05$) reflecting similar radial growth rates. The three fungal isolates grown on BH agar plates were inoculated into BH culture broths amended with crude oil and a disintegrated crude oil layer with the developed mycelial strands was observed after a 28 day incubation period. Further microscopic observations of the oil particles confirmed an extensive growth of mycelial strands on the oil particles along with conidia bearing conidiophores. In conclusion, the three *Penicillium* species isolated in this study, are capable of utilizing crude oil as the sole source of carbon and energy, and could be considered as potential crude oil degraders. Further molecular identification of the fungal isolates and their relative crude oil degrading capacities under different optimization conditions should be carried out in future studies.

Keywords: Petroleum hydrocarbon, indigenous fungi, *Penicillium* sp.

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937/D

Optimization of the dosage of *Phyllanthus maderaspatensis* (Family: Euphorbeaceae) to improve serum lipid profile in Wistar rats (*Mus norvegicus albinus*)

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Over accumulation of cholesterol in blood leads to hypercholesterolemia with severe health consequences. A recent study revealed the anti-hypercholesterolemiceffectiveness of *Phyllanthus maderaspatensis*. The present study investigated the dose-dependent response of the crude methanolic extract of *P. maderaspatensis* (CME-PM) in Wistar rats, to determine its effective dose. A hypercholesterol diet was orally introduced to male rats (n = 6/group) until the total cholesterol levels were significantly increased ($p \leq 0.05$) (around 123.45 mg/dl) compared with the rats treated with a standard diet. Since 2000mg/kg is the least acute dose recommended by OECD guideline No. 423, three CME-PM doses below that level, 400, 800 and 1200 mg/kg were selected, to be administered orally once a day for forty two days. Serum lipid parameters were measured at 0th, 14th, 28th and 42nd days after treatments. Increasing CME-PM concentrations showed dose dependent negative responses with total cholesterol, triglycerides and LDL-C, as well as a dose dependent positive response with HDL-C ($p \leq 0.05$). When compared with the cholesterolemic untreated group, the levels of total cholesterol, triglyceride and LDL-C were lowered significantly in all three doses ($p \leq 0.05$) and this trend increased with the time. With HDL-C the response increased ($p \leq 0.05$) by all three doses and this response also increased with the time. When a regression analysis was performed for the three doses at 42nd day, correlations were found for total cholesterol ($r^2 = 0.90$), triglyceride ($r^2 = 0.97$), HDL-C ($r^2 = 0.83$) and LDL ($r^2 = 0.87$). By the 42nd day 1200mg/kg dose had insignificant ($p > 0.05$) total cholesterol levels, triglyceride and HDL-C compared with the negative control. LDL-C level was not lowered up to the level of negative control even by 42nd day. Results revealed that, 1200mg/kg dose of CME-PM is the effective dose for reducing total cholesterol and triglyceride and elevating HDL-C up to normal level.

Keywords: Cholesterol, Wistar rats, *Phyllanthus maderaspatensis*

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938/D

Genetic diversity and population dynamics of dengue vectors *Aedes aegypti* and *Aedes albopictus* in selected localities in Sri Lanka

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Aedes aegypti and *Aedes albopictus* are the two main vectors of the dengue virus. Knowledge of vector genetic diversity would be useful in vector control, as it reflects the evolutionary potential of vectors. Similarly, vector population dynamics would be useful in estimating effectiveness in vector control strategies. Therefore, this study was undertaken to estimate the genetic diversity and population dynamics among selected populations of *Aedes aegypti* and *Aedes albopictus* in Sri Lanka, using Exon Primed Intron Crossing (EPIC) markers. Larval samples of each species were collected from two dengue endemic areas, Colombo (N=32) and Galle (N=30) for *Ae. aegypti* and Gampaha (N=20) and Kalutara (N=30) for *Ae. albopictus*. DNA was extracted and PCR amplified for RpS20 and RpL30 markers followed by 6% PAGE. PCR amplicons were sequenced and analyzed with Clustal WinMega 7.0.14. DnaSP 5.10 was used to infer the nucleotide diversity (π and θ), InD diversity ($\pi(i)$), haplotype diversity (Hd), average number of nucleotide differences (k) and Fu and Li's D* and F* statistics. An average of 480 and 464 bp DNA fragments were analyzed for the two markers for *Ae. aegypti* and *Ae. albopictus*, respectively. The values obtained for π , $\pi(i)$ and k were slightly higher for *Ae. albopictus* compared to *Ae. aegypti*, but were not significantly ($P > 0.05$) different ($\pi_{alb}:\pi_{aeg} = 0.0333:0.0165$; $\theta_{alb}:\theta_{aeg} = 0.0508:0.0149$; $\pi(i)_{alb}:\pi(i)_{aeg} = 1.2733:1.049$; $k_{alb}:k_{aeg} = 8.801:3.544$). However, a significantly higher Hd was observed for *Ae. albopictus* (0.913) in comparison to *Ae. aegypti* (0.675). The obtained π values for the two species were comparable with previous studies conducted in other regions of the world, i.e., *Ae. albopictus* from Indonesia (0.03878), *Ae. aegypti* from Australia (0.0202) and Brazil (0.0102). Nevertheless, $\pi(i)$ observed in the present study for *Ae. aegypti* is significantly higher compared to the reports from Australian populations (0.0052) ($P < 0.05$). Further, *Ae. albopictus* population at Imbulgodash showed significantly negative FLD* (-2.558) and FFL* (-2.716) values with respect to the RpS20 marker ($P < 0.05$) indicating possible population expansion events. The population tested indicate a high and comparable level of genetic diversity among *Ae. aegypti* and *Ae. albopictus* found in Sri Lanka reflecting their substantial evolutionary potential. The suggested population expansion in *Ae. albopictus* is further evident with the high haplotype diversity, and may require caution with respect to controlling dengue transmission.

Keywords: EPIC markers, Fu and Li's D* and F*, nucleotide diversity, population expansion, vector genetics

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939/D

Determination of the antioxidant activity of *Averrhoa carambola* (Star fruit) in

Sri Lanka

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Averrhoa carambola (star fruit) is an underutilized tropical fruit, found mostly in Southeast Asia including Sri Lanka. Star fruit is rich in antioxidant properties and has provided a remarkable contribution to medicine and the pharmaceutical industry. The current study was carried out to evaluate the phytochemical content and antioxidant properties of the star fruit in Sri Lanka. The peel and the pulp of the raw and ripe fruit was subjected to methanol extraction. Total phenolic content (TPC), total flavonoid content(TFC), and total antioxidant capacity (TAC) were used to test the phytochemical content. The antioxidant activity was determined by the 2,2-Azino-bis-3-ethylbenzothiazoline-6-sulfonic Acid (ABTS) and Ferric Reducing Antioxidant Power (FRAP) assays. Results demonstrated that the highest TPC and TFC were observed in the ripe peel followed by raw peel, raw pulp and ripe pulp of the fruit ($p < 0.05$). Antioxidant activities of the plant extracts based on ABTS, FRAP and TAC indicated highest activity in ripe peel followed by raw peel and pulp, and ripe pulp, separately. In conclusion, the study demonstrated that the ripe peel of the Sri Lankan star fruit contained the highest phytochemical properties and antioxidant activity.

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940/D

Screening of selected plants in genera *Psychotria* and *Hedyotis* for its antimicrobial activity and cyclotides.

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Plants produce an enormous variety of natural products with highly diverse structures. Among them cyclotides are the largest known family of head-to-tail cyclic peptides that have a unique and extremely stable three-dimensional structure. They have been discovered in a range of plant families including Violaceae, Rubiaceae, and Fabaceae, that show a range of biological activities, antimicrobial, antiviral, cytotoxic, antioxidant etc. In this research, seven plant species from the genera *Psychotria* and *Hedyotis* belonging to family Rubiaceae were selected to screen for antimicrobial activity and cyclotides. Methanol and ethanol extracts of plant leaves were tested for antibacterial activity using agar disk diffusion assay, and distilled water extracts of plant leaves were tested using agar well diffusion assay, against four bacterial species, *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Antifungal activity was tested for the three fungal species, *Aspergillus*, *Penicillium*, and *Curvularia*, by food poisoning assay. The Methanol and ethanol extracts of three plant species, *Psychotria zeylanica*, *Psychotria sarmentosa*, and *Hedyotis trimanii*, showed positive results for antibacterial activity against *S.aureus*, *B. cereus* and *P. aeruginosa*. Distilled water extracts of the *P. sarmentosa* (*Gonica* in Sinhala) showed strong antibacterial activity against *S. aureus*, (14.0 ± 1.0 mm) and *P. aeruginosa* (14.0 ± 0.5 mm). Although this plant is being used to treat bone fracture in Deshiya Chikitsa in Sri Lanka, its antibacterial potential was not reported in the Sri Lankan Ayurvedic Pharmacopoeia. Then all plant extracts were tested by reverse phase column chromatographic and mass spectroscopic techniques to identify the presence of cyclotides. The results of the chromatographic techniques showed that none of the plant species tested contain cyclotides. To further identify the antibacterial active components from the plant *P. sarmentosa*, the crude extract was subjected to bioassay guided fractionation using silica gel column chromatography and TLC. The isolated bioactive fractions in FTIR analysis showed the bioactive compounds presents in *P. sarmentosa* could be hydroxyl, alkyl and alkenyl groups.

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941/D

Isolation and screening of potential antibiotic producing bacteria from soil

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The current study was carried out to isolate antibiotic producing bacteria from soil which provides a perfect residence for diverse microbial interactions, including the antagonism phenomenon, which leads to the production of antibiotics or metabolites by one organism that inhibit another organism. Antibiotics, which are a significant discovery in history, have been used as therapeutic drugs in treating infectious diseases. Bacteria are easy to isolate, culture, and maintain, and to improve the strain. Thus the isolation of soil bacteria was carried out by using three culture media: nutrient agar which was used to isolate bacteria, while starch casein agar and glycerol arginine agar were used to isolate slow growing bacteria like Actinobacteria. Screening was done by using some common opportunistic pathogens (*S. aureus*, *B. subtilis*, *P. aeruginosa*, *E. coli*). Bacterial isolates were tested for antibiotic production against these standard cultures via cross streak screening method and spot inoculation method. Six bacterial isolates were successfully isolated by the cross streak screening method while only two bacterial isolates were isolated through the spot inoculation method. As screening for antibiotic producers is a tedious and time consuming process, isolation of antibiotic producers demands effective rapid screening methods. According to this study it is evident that more promising results can be obtained by the cross streak method than the spot inoculation method. Also this study further suggests that the genus *Pseudomonas* has a significant potential to synthesize antibiotics.

Keywords: Soil bacteria, Antibiotics, *Pseudomonas*

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942/D

Biochar as a sustainable solution for pollution remediation from the municipal solid waste dumps in Sri Lanka

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Pyrolysis of municipal solid waste (MSW) is a thermal conversion process which can be successfully used to transform the organic waste into energy and a value added by-product, Biochar. Since the estimated biodegradable portion is prominent and denoted as 60% from the total waste generation in Asian developing countries, pyrolysis will be a promising solution for the MSW open dumps. The objectives of this study were to evaluate physicochemical characteristics of MSW biochar (MSW-BC) produced from Organic MSW as a sustainable solution for landfill contaminant remediation. Biochar was pyrolyzed from the MSW in an onsite pyrolyzer around 450 °C with a holding time of 30 min. For physicochemical properties of biochar, pH, point of zero charge, electrical conductivity, proximate analysis, ultimate analysis, heavy metal composition, bioavailable heavy metal composition, and BET surface area were determined, in order to study its potential to be used as a sustainable material for pollution control at the open dumps. In addition, surface functional groups and structural identification were determined by respectively FTIR analysis and scanning electron microscopy analysis. Adsorption capacities for the volatile organic compounds (VOCs) (benzene, xylene and toluene) were examine by batch sorption experiments. The ultimate analyses results indicated that the low molar O/C ratio is due to high pyrolytic temperature derived MSW-BC. Additionally, FTIR suggested a loss of labile, aliphatic compounds and functional groups during pyrolysis and the formation of more recalcitrant, aromatic constituents, whereas BET and SEM data revealed a well developed porous structure and surface properties, which indicates MSW-BC to be a potential sorbent. Further, reported total and bioavailable heavy metal content were low in MSW-BC, hence it can be easily mixed with compost and used as a fertilizer. At the same time, MSW-BC will potentially be used to remediate heavy metals in the landfill leachate. Furthermore, MSW-BC demonstrated a strong ability to remove VOCs, and hence it can easily be used as a landfill cover and permeable reactive barrier material. Thus, conversion of MSW to BC would allow effective engineering to optimize their properties to be used as a potential material for sustainable resource management.

Keywords: Biochar, VOC, Landfill leachate.

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943/D

Poultry Manure, a Potential Fertilizer Source for Increasing Mg levels in Coconut Plantations

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Nutrient balance in coconut plantations is one of the major requirements for the expected national production of 3000 million nuts per year. The Coconut Research Institute has introduced fertilizer recommendations based on four major nutrients N, P, K, and Mg, through chemical fertilizer, organic manure, or with different combinations of both chemical and organic fertilizers. Magnesium deficiency has been the most prevalent in coconut plantations grown in Wet and Intermediate zones even with regular application of chemical fertilizers, with either visible deficiency or the hidden deficiency of being less than the sufficiency range of Mg (0.25-0.35%) in leaves. In the present case study, major nutrient levels were compared under two different fertilizer practices, *i.e.*, poultry manure (30 kg) with 2 kg of dolomite and 1 kg of muriate of potash (MOP) for two consecutive years and the application of the current recommended fertilizer sources. Six palms were randomly chosen, and leaf samples from 14th frond and soil samples at a depth of 20 cm from 90 – 120 cm away from the base of the palm were collected. All samples were analyzed for major nutrients and soils were analyzed for their pH, EC, and organic carbon content. Difference in parameters was determined by performing the *t*-test. Significantly higher ($P \leq 0.05$) levels of Mg (0.37%), Ca (0.46%) and P (0.16%) were observed in poultry manure treated palms compared to the inorganic fertilizer applied palms which showed 0.25%, 25%, and 0.11% respectively. The higher levels of Mg, Ca, and P were further reflected with the higher availability of those nutrients in the soil while having higher EC in poultry manure treated plots than that of the other. An important point revealed by this data is the significant ($P \leq 0.05$) increase of Mg levels in coconut palms with the application of poultry manure with dolomite. Such an observation has also been recorded previously in another experimental site in Intermediate Zone with higher levels of Mg (0.35%) after application of poultry (30 kg) with 250 g of MOP as a K supplement for six years in comparison with other organic sources. Accordingly, the present results indicated that poultry manure is a potential source to increase Mg levels in coconut plantations.

Keywords: Nutrients, fertilizer source, poultry manure, deficiency.

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944/E1

Synthesis of reduced graphene oxide from local graphite using alternative microwave method

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Reduced graphene oxide (RGO) has attracted wide attention due to various applications, such as super capacitors, sensors, solar cells, batteries, transistors, and nano electronics, due to its unique properties such as high surface area, stability, conductivity, and flexibility. RGO can combine with metal oxide, which results in formation of nanocomposites, which may improve the properties of RGO. In this study, Graphite Oxide (GO) was synthesized from Kahatagaha vein graphite mined in Sri Lanka, using a modified version of the common Hummer method first, from which RGO was synthesized using the microwave assisted hydrothermal method. Attention has been paid in this study to use an alternative and cheap domestic microwave oven of power 800W for the first time, instead of the higher power reported elsewhere. In addition, a pure form of graphite (above 99%) was used. The prepared products (GO, RGO) were characterized using X-Ray Diffraction Spectroscopy (XRD) and Fourier transform infrared spectroscopy (FTIR). In the XRD pattern of GO, the peak at about $2\theta = 11^\circ$ disappeared, confirming successful reduction of GO to RGO, and a low intensity broader peak appeared at $2\theta = 26^\circ$, revealing successful formation of RGO in 15 minutes. The bands at around 1544 cm^{-1} of the FTIR also very clearly shows the formation of RGO. Therefore, the domestic microwave oven is suitable to successfully convert GO into RGO in 15 minutes using lower power. The obtained RGO is pure since highly pure graphite was used.

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945/E1

**Investigation of Effect of temperature on the Transmission of Dengue Fever and Using Its
Result to Propose an Eradication Strategy**

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Dengue fever is a mosquito-borne viral disease. Dengue fever is a local epidemic in Colombo with the highest peak in June to August. It is believed that the temperature is an important factor for dengue transmission. The SIR mathematical model was used to evaluate the impact of temperature in the transmission of dengue infection. The secondary data of climatic condition and number of dengue incidences were derived from Colombo during 2010-2014. All calculations in this study were carried out using Matlab, with ODE45 function for solving differential equations. The simulations suggest that the optimal temperature range for the dengue transmission is 28-29°C. Increasing the yearly mean temperature by 0.1°C, the number of dengue incidences can be increased by 80-90% during the optimal temperature range. The study result has shown that the spread of dengue virus (DENV) depends on the seasonal variation of the temperature. The temperature is important for the life cycle and behavior of the mosquitoes. However, a very high or very low temperature reduced the number of dengue infection cases. The model simulation indicates that the peak of adult mosquito population is in May and peak of the infected mosquito population is in July, with two months lag according to the temperature. The study proposed eradication strategies to reduce dengue incidences in Colombo.

Keywords: Dengue transmission, dengue virus, SIR model

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946/E1

Non-destructive analysis of monitoring the ripeness in mature lime fruit by pulse excitation technique

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This study describes the design and construction of a mechanical device providing a non-destructive measurement of propagation times of pulsesthrough lime fruits, which monitor the states of ripeness of the fruits. The design has two rigid vertically mounted Perspex plates where a lime fruit was placed on the soft bed in between the two plates. When a pulse-excitation is given to one plate in contact with the fruit, the excitation propagates through the fruit, and the response is detected by a piezo sensor attached to the other plate. Both signals were acquired by a PC for time measurements. Measurements were taken on fruits labeled as A (initial mass 29.41 g), B (initial mass 53.62 g) and C (initial mass 60.08 g) for 8 consecutive days. Average values of stiffness index $S = \rho r^2 / \Delta t^2$ (where ρ - density of fruit, Δt - the propagation time of a pulse, r - average radius of fruit) were computed. The plot of S (in Pa) vs. storage time (in days) (Fig. 1) showed a negative slope in relation to the ripening process of each fruit, confirming S could be used as an indirect parameter to monitor the states of ripeness of fruits. Fig. 1 further shows that fruits having a lower mass are ripening more rapidly than the ones with a higher mass. Investigations are being carried out to confirm this observation.

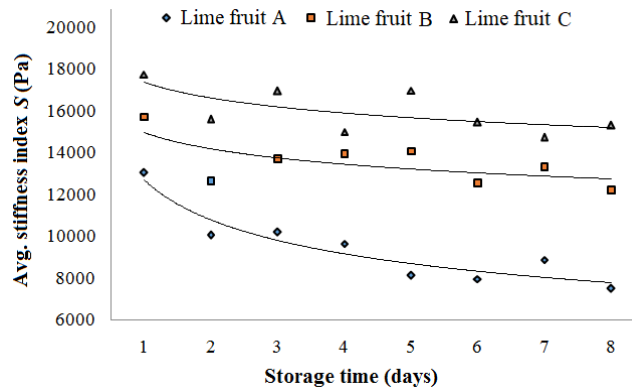


Fig.1: The stiffness index S (in Pa) vs. storage time (in days) of lime fruits

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947/E2

Study on variation of amylose content and hydration properties of selected paddy varieties during storage

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Various physical and chemical changes occur in cereals during storage. A study was designed to determine occurrence of variations in physical and chemical properties of selected paddy varieties during early storage at ambient temperature conditions. Amylose content, swelling power (SW) and water binding capacity (WBC) of paddy varieties were selected, to investigate the changes occurring during four months storage. Three freshly harvested paddy varieties, namely BG 300, BG 352 and AT 362, were selected for the study. All cleaned and dried samples were stored in separate plastic baskets at ambient temperature conditions. Amylose content, swelling power and water binding capacity of all varieties were tested in every two weeks, up to four months storage period. The data obtained from the study were statistically analyzed using one way ANOVA (CI=95%) to determine the variation of selected physical and chemical properties during four months storage. There were no significant variations in amylose contents of each paddy variety during this period ($p < 0.05$). The swelling power values of BG 352, BG 300, and AT 362 varieties did not have a noticeable increase from the 1st week to 5th week. From then onwards, it significantly increased from 7.49 ± 0.06 g/g, 7.15 ± 0.10 g/g, and 7.29 ± 0.04 g/g to 8.43 ± 0.03 g/g, 8.05 ± 0.09 g/g and 7.73 ± 0.05 g/g, respectively. Water binding capacities of three paddy varieties showed an incremental trend during the four months storage. Water binding capacity of BG 352, BG 300 and AT 362 varieties significantly rose from 0.97 ± 0.007 g/g, 0.956 ± 0.052 g/g and 1.199 ± 0.082 g/g to 1.179 g/g ± 0.021 , 1.112 ± 0.070 g/g and 1.520 ± 0.008 g/g, respectively during the study period. Even though there is no remarkable variation of amylose content of each variety during the four months' storage, hydration properties of all varieties increased significantly. Hence, it can be concluded that amylose is not the single factor that governs the changes in physical properties of paddy such as stickiness, water absorption, and swelling power following storage. Individual or interaction effect of other component of rice including starch, protein and lipid could be the reason for variations in physical and chemical properties of rice during storage.

Key words- Rice aging, Amylose content, Swelling power, Water binding capacity.

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948/E2

Antioxidant properties of selected pigmented whole long grain rice varieties of Sri Lanka

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Highly polished, long grain, white rice is the most popular rice in international trade. However, the demand for pigmented, whole, long grain rice has increased, as they are rich in nutrients and naturally derived antioxidants. In Sri Lanka, several long grain rice varieties (RVs) with 'Basmathi' type grain qualities, and a black pericarp rice variety have been recently developed and commercialized. However, the antioxidant properties (AP) of such RVs are less investigated to date. The present study investigated the AP of selected pigmented whole long grain RVs developed in Sri Lanka.

A locally developed long grain, red pericarp, basmati type rice variety and a black long grain rice variety were used in the study. 70% Ethanol extracts of whole grain rice flour of these two varieties were studied for total polyphenolic content (TPC), ferric reducing antioxidant power (FRAP), 2,2-diphenyl-1-picrylhydrazine (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) radical scavenging activities and oxygen radical absorbance capacity (ORAC) AP *in vitro* (n=3 each).

Results showed that both varieties tested had AP in all the assays tested with varying degrees of potentials. Black rice exhibited significantly high ($P < 0.05$) FRAP (38.58 ± 0.73 mg Trolox/g extract) and ORAC (107.58 ± 2.65 mg Trolox/g extract) whereas red rice demonstrated significantly high ($P < 0.05$) DPPH radical scavenging activity (120.23 ± 0.80 mg Trolox/g extract). For, TPC (red: 26.00 ± 2.21 mg gallic/g extract; black: 27.67 ± 0.89 mg gallic/g extract) and ABTS radical scavenging activity (red: 72.19 ± 1.92 mg Trolox/g extract; black: 75.18 ± 0.73 mg Trolox/g extract) the difference between the two rice varieties were insignificant ($P > 0.05$). Compared to the reference standards used both varieties showed moderate activities for the tested antioxidant properties.

It is concluded that both red and black whole long grain rice varieties studied had AP in all the assays tested with different degrees of potential. Thus, consumption of these two varieties as whole grains may be important in prevention and dietary management of oxidative stress associated chronic diseases.

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949/E2

A preliminary investigation of the antioxidant activity of *Manihot esculenta Crantz* in Sri-Lanka

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Cassava (*Manihot esculenta Crantz*), is a widely grown crop in Sri Lanka which is known to cure headache, hypertension, conjunctivitis, diabetes, inflammatory diseases, and cancer. Phytochemicals like alkaloids and flavonoids present in *M. esculenta Crantz* can initiate the antioxidant, antimicrobial and anti-carcinogenic effects. Hence, the objective of the study was to investigate the phytochemical composition and antioxidant capacity in cassava root, and young and mature leaves. The cassava root and young and mature leaves were sun dried, pulverized and extracted with methanol. The total phenolic (TPC) and flavonoid (TFC) content was analyzed using the Folin-Ciocalteu reagent assay and aluminium chloride colorimetric method, respectively. Moreover, the total antioxidant content (TAC) was assessed using the ammonium heptamolybdate tetrahydrate method and the antioxidant activity was determined by the 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) and ferric reducing ability of plasma (FRAP) assays. The TPC in mature leaves was found to be the highest 2524.2 ± 7.8 mg of GAE per L compared to other samples ($P = 0.00$, $p < 0.05$) and the TFC was also significantly high in mature leaves 2292.4 ± 34.6 ($P = 0.00$, $p < 0.05$) mg of rutin equivalents per L. Antioxidant activities of the extracts based on the ABTS, FRAP and total antioxidant capacity demonstrated a high activity in mature leaves, followed by young leaves and root. Additionally, correlations of TAC/TPC and TAC/TFC showed a positive linear correlation of 0.998 ($P = 0.042$, $p < 0.05$) and 0.961 ($P = 0.018$, $p < 0.05$), respectively. These correlations signify that both phenols and flavonoids are responsible for the radical scavenging activity in cassava. Moreover, as the correlation between TAC/TFC is lower than TAC/TPC, it signifies that flavonoids belong to the subclass of phenols. In conclusion, the mature leaves demonstrated a higher radical scavenging activity together with high amounts of phenols and flavonoids, whereas roots contained the least amount of radical scavenging activity, and had the lowest amount of phenols and flavonoids.

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950/E2

Anti-bacterial activity of selected *Barringtonia asiatica* seed kernel fractions against bacteria

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The research for more efficient and novel antimicrobials with fewer side-effects on human health is important due to development of antibiotic resistance by bacteria. Thus the aim of this study was to assess the antibacterial potential of two extracts obtained from *B. asiatica* seed kernel. The fruits of *B. asiatica* have been used as a fish poison and contain saponins. The crude methanolic extract (15 g powder / 40 mL MeOH, 24 hrs, dried at 45°C in a rotary evaporator) and a fraction obtained following running the crude methanolic extract (CME) through medium pressure liquid chromatography (MPLC), both of which had shown cytotoxicity with brine shrimp assay, were used. The CME (5000ppm) and the fraction from MPLC (5000ppm) were tested for antibacterial activity against standard ATCC strains of *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli* and their clinical isolates obtained from a diabetic patient's wound. The antibacterial assays were done using Muller Hinton Agar (MHA) medium, with well diffusion method. CME or fraction of MPLC, Vancomycin (30 mg/mL, *S. aureus*, *E. faecalis*) or Gentamycin (30 mg/mL, *P. aeruginosa*, *E. coli*) were used as positive, and dimethyl sulfoxide (5%, DMSO) were used as negative controls. The zone of inhibition was measured after incubation at 37°C for 24 hours (n=3). MPLC fraction resulted in a 14 mm zone of inhibition only for *P. aeruginosa* (ATCC 27853) and *S. aureus* (ATCC 25923) was inhibited only by CME (11 mm). CME did not inhibit the growth of *P. aeruginosa* and the MPLC fraction was inactive against *S. aureus*. The growth of their clinical isolates was also not inhibited. The growth of *E. faecalis* (ATCC 29212), *E. coli* (ATCC 25922) and their clinical isolates were not inhibited by the CME or the MPLC fraction. According to the results, CME and MPLC fraction of *B. asiatica* have shown low antibacterial activity against the bacterial strains studied.

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951/E2

Isolation and identification of glucose oxidase producing fungi from Nelumwewa and Maha Oya hot water springs, Sri Lanka

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Glucose oxidase has a wide range of industrial applications, and the main focus of this study was to isolate fungi with thermostable glucose oxidase activity from Sri Lankan hot water springs. Water samples collected from Nelumwewa and Maha Oya hot water springs in the Polonnaruwa district were subjected to serial dilution and inoculated on a medium contained peptone, glucose, agar, and chloramphenicol, and incubated at 30°C for 6 days. In total, six fungal colonies were isolated and screened for glucose oxidase production, which was done using two different media. Screening medium I consisted of glucose, peptone, o-dianisidine, horseradish peroxidase and agar. Enzyme production was indicated by the appearance of brown color ring around the colony. Screening medium II consists of two layers. The bottom layer contained glucose, peptone, CaCO₃ and agar, and the top layer contained glucose, KI, starch and agar. Wells were created on top layer and isolated fungi colonies were inoculated into the wells. Upon enzyme production, a blue/violet color appeared on the top layer around the colony. Fungus colonies showing glucose oxidase production were grown on slants containing peptone, glucose, and agar and incubated at 30°C for 14 days until sporulation. Slants were washed with sterile water and pooled. Submerged fermentation was done in a medium containing NaNO₃, KH₂PO₄, MgSO₄.7H₂O, FeSO₄.7H₂O, CaCO₃, peptone, and glucose. Spore suspension and fermentation medium was used in 1:19 ratio for submerged fermentation. It was incubated at 30°C for 3 days on a rotary shaker and the activity obtained was 0.85U/mL. The fungus having highest glucose oxidase production was identified morphologically, as well as by 18s rRNA sequencing, as *Talaromyces funiculosus* (Genbank: KT148636.1) and catalogued as *Talaromyces funiculosus* AMS1. All media used in this study has the pH of 5.6±0.2 and Sigma Aldrich standard glucose oxidase assay was used in enzyme activity calculation. Further studies are in progress to investigate the industrial applicability of glucose oxidase obtained from the fungus *Talaromyces funiculosus* AMS1.

Keywords: Glucose oxidase, *Talaromyces funiculosus* AMS1.

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Purification and characterization of thermostable glucose oxidase from *Talaromyces funiculosus* AMS1 isolated from Nelumwewa hot water springs

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The industrial uses of glucose oxidase are in glucose biosensors and food and beverage industries. *Talaromyces funiculosus* AMS1 isolated from Nelumwewa hot water springs in the Polonnaruwa district has been shown to produce glucose oxidase. The main focus of this study was to purify and characterize the enzyme glucose oxidase from *Talaromyces funiculosus* AMS1. The isolated fungus was inoculated on agar slants consisted of peptone, glucose, and agar, at a pH of 5.6 ± 0.2 , and was incubated at 30°C for 14 days until sporulation. Spores were washed with sterile water and pooled. Spore suspension was used as the inoculum for submerged fermentation and it was done in a medium consisted of NaNO_3 , KH_2PO_4 , $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, CaCO_3 , peptone, and glucose at a final pH of 5.6 ± 0.2 . To determine the effect of temperature on enzyme production, submerged fermentation was carried out at different incubation temperatures (25°C , 30°C , 35°C and 40°C) on a rotary shaker, using fermentation medium and spore suspension in a 19:1 ratio. The highest glucose oxidase production was obtained at 30°C which was 3.3 U/ml after incubation for 88 hours. 428U/mg specific activity with 12 fold purification and 24% yield was obtained after purification by $(\text{NH}_4)_2\text{SO}_4$ fractionation, dialysis and DEAE Sephadex A-25 anion exchange chromatography. Homogeneity of the purified enzyme was determined by polyacrylamide gel electrophoresis in which single band was observed at the R_f value of 0.29. The optimum temperature and pH for the enzyme activity were 40°C and 5.1 respectively. 90.8% of its original activity was retained after 60 minutes of incubation at 40°C . The K_m and V_{max} values for β -D-glucose were 6.91 mM and 0.74 $\mu\text{mol}/\text{min}/\text{mg}$, respectively. The effect of salts on glucose oxidase activity was investigated by incubating the enzyme in 0.1mM salt solutions and it was observed that the enzyme was completely inhibited by Fe^{2+} , Hg^{2+} and Ag^+ . A decrease in enzyme activity was obtained by Na^+ , Mg^{2+} , Ca^{2+} , Co^{2+} , Zn^{2+} , Cd^{2+} , and Cu^{2+} . The purified enzyme was shown to have a good stability at 40°C and further studies are in progress to investigate the potential industrial applications.

Keywords: Glucose oxidase, *Talaromyces funiculosus* AMS1, DEAE Sephadex A-25

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953/E2

**Purification and functional characterization of thermostable alpha amylase from
Caldimonas manganoxidans MS1 isolated from Maha Oya hot water spring in
Sri Lanka**

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We have previously isolated the thermophilic bacteria *Caldimonas manganoxidans* MS1 from Maha Oya hot water spring in Ampara District of Sri Lanka and biochemical properties were characterized and identified by 16S rRNA gene sequencing. In this study we have purified the α -amylase from *Caldimonas manganoxidans* MS1 to homogeneity, which was confirmed by polyacrylamide gel electrophoresis. Functional properties were characterized to determine its suitability for the industrial applications. Enzyme production was optimized by varying the culture conditions. The maximum production of 31 U/mL was obtained with a medium containing 10% soybean flour, 1% soluble potato starch, 0.5% NaCl enriched with 0.5 g/L KCl, 0.5 g/L $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.04 g/L MnSO_4 , 0.3 g/L FeSO_4 , 0.87 g/L K_2HPO_4 , and 0.022 g/L CaCl_2 , after 18 hours of incubation at 50°C and pH 6.9 with a maximum cell count of 1.8×10^7 . The precipitate obtained at 40% ammonium sulphate saturation showed an activity of 25 U/mL with a recovery of 74% at 1.2 fold purification after dialysis. The purified enzyme obtained after DEAE-Sephadex A-25 ion exchange chromatography showed an activity of 19 U/mL and a specific activity of 467 U/mg at 18 fold purification with a recovery of 49%. A single band in polyacrylamide gel electrophoresis indicated homogeneous purification. The purified enzyme showed a maximum activity at 50°C and pH 6.9. The enzyme was stable from 10-50°C and pH 6-8. The enzyme activity was enhanced in the presence of Ca^{2+} , Mg^{2+} , Mn^{2+} , Fe^{2+} , Co^{2+} , Zn^{2+} and Na^+ while Fe^{3+} , Cu^{2+} , AsO_4^{3-} , Cd^{2+} , Hg^{2+} , EDTA, SDS and Clorox showed inhibition of enzyme activity. The enzyme retained 83% and 88% of its activity in presence of SDS and TritonX-100 respectively. This suggested possible application of the enzyme in detergent industry. From the kinetic studies, the obtained K_m and V_{max} values from the Lineweaver-Burke plot were 1.33 mg/mL and 33 $\mu\text{mol}/\text{min}/\text{mL}$ respectively.

Keywords: α -Amylase, *Caldimonas manganoxidans* MS1, DEAE-Sephadex A-25, Polyacrylamide gel electrophoresis.

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Isolation, biochemical characterization, and identification of thermostable alpha amylase producing bacteria from hot water springs in Sri Lanka.

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The bacteria isolated from hot water springs are good sources of thermostable α -amylases, which can be used in industries in Sri Lanka. In this study we have isolated and characterized biochemical properties of thermostable α -amylase producing bacteria from two hot water springs in Sri Lanka. Water samples were obtained from Maha Oya (Ampara District) and Nelumwewa (Polonnaruwa District) hot water springs. Soil-water mixtures were also collected from Nelumwewa. The highest temperature of 57°C was recorded at Maha Oya. Selected samples were inoculated into starch nutrient broth containing 1% (w/v) soluble starch as the carbon source (pH was 6.9). The enrichment of thermostable α -amylase producers was done by incubating the cultures for 72 hours at 50°C. The enriched samples were inoculated into starch nutrient agar plates by the streak plate and spread plate methods. The isolated strains were screened for α -amylase production using the starch hydrolysis test. Altogether ten different strains of bacteria were isolated. Four strains (S₁2, S₁8, S₂1, and S₅1) were selected based on starch hydrolysis test on starch nutrient agar plates. The strains were further characterized by morphological and biochemical tests. The organism S₅1 was the most efficient α -amylase producer among the above 4 strains, which was confirmed by starch utilization analysis in starch nutrient broth by the dinitrosalicylic acid (DNS) method. The strain S₅1 was isolated from the water sample collected from a well at Maha Oya hot water springs which recorded the highest temperature of 57°C. The selected species produced 1.85 mg/mL of reducing sugars (as maltose) in 12 hours. 16S rRNA gene sequencing revealed the organism S₅1 was 99% similar to the organism *Caldimonas manganoxidans* (GenBank Accession No. NR 113844.1). The bacteria was named as *Caldimonas manganoxidans* MS1, which is a good alpha amylase producer, therefore the research was continued for the purification and functional characterization of the thermostable alpha amylase from *Caldimonas manganoxidans* MS1.

Key words: α -Amylase, *Caldimonas manganoxidans* MS1, Thermostable

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Screening of three selected medicinal plant extracts for *in vitro* antioxidant activity

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Medicinal plants have long been used for the management of chronic kidney disease (CKD) in Sri Lanka. Oxidative stress has been recognized as one unifying mechanism in the pathogenesis of CKD. Medicinal plant derived natural antioxidants, which act in the form of crude extracts, are known to be beneficial in the reduction of cellular oxidative stress. The objectives of the present study were to determine the total antioxidant activity, total polyphenol content and total flavonoid content of three selected medicinal plants widely used in Ayurvedic medicine for the treatment of kidney diseases in Sri Lanka. The medicinal plants selected were *Asparagus falcatus* (Hathawariya, Family: Liliaceae), *Plectranthus amboinicus* (Kapparawalliya, Family: Lamiaceae) and *Vetiveria zizanioides* (Savendara, Family: Gramineae). The plants were collected from the natural habitat in the Southern region. Hot water refluxed (4 h) leaf extracts of *A. falcatus* and *P. amboinicus*, and the root extract of *V. zizanioides* were used in the study. The antioxidant activity was determined by ferric reducing antioxidant power (FRAP) assay. L-Ascorbic acid was used as the reference compound. Total polyphenol content and total flavonoid content were estimated using the Folin-Ciocalteu method (reference compound: gallic acid) and aluminum chloride method (reference compound: quercetin), respectively. The samples were analyzed in triplicate. The FRAP values of the three plant extracts were in the descending order of *P. amboinicus* ($18.0 \pm 0.2 \mu\text{M}$), *A. falcatus* ($14.3 \pm 0.8 \mu\text{M}$) and *V. zizanioides* ($8.1 \pm 0.2 \mu\text{M}$). The total polyphenol contents of the three plant extracts were 3.9 ± 0.03 , 5.7 ± 0.05 and $1.8 \pm 0.03 \mu\text{g GAEg}^{-1}$ dry plant material respectively. The highest and the lowest total flavonoid contents were obtained from the extracts of *P. amboinicus* ($1.9 \pm 0.05 \mu\text{g QE g}^{-1}$ dry plant material) and *V. zizanioides* ($0.57 \pm 0.01 \mu\text{g QE g}^{-1}$ dry plant material). Positive correlations were obtained for total polyphenol content vs. FRAP value ($r = 0.99$) and total flavonoid content vs. FRAP value ($r = 0.99$). The results revealed that the selected plant extracts exert considerably high antioxidant activity. In addition, polyphenol compounds and flavonoids present in the plant extracts contribute significantly to its antioxidant activity. The three medicinal plant extracts exert promising antioxidant activity justifying further experiments on the development of novel pharmaceutical agents or nutraceutical products targeting the diverse free radical pathologies of CKD.

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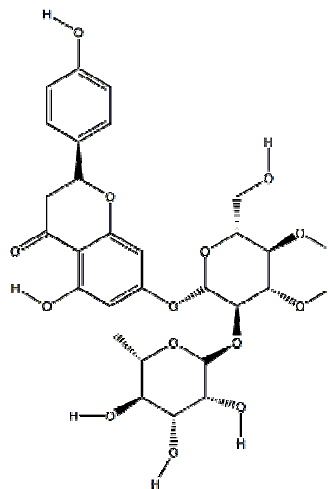
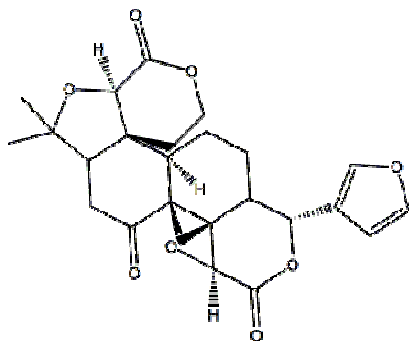
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Identification of main chemical compound responsible for the bitterness in pasteurized juice of “Bibila sweet” oranges

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Development of bitterness in citrus juices after pasteurizing treatment is a prominent industrial problem. The aim of this study is to determine the major chemical compound or compounds responsible for the bitterness in “Bibila sweet” oranges. Limonin and naringin are the two major bitter compounds in citrus juices, which belong to limonoids and flavonoids respectively. A sensory evaluation was conducted as the preliminary study and this indicated that the bitterness developed after the pasteurizing treatment. Ultra-high performance liquid chromatography (UHPLC) technique was used to determine the concentration of limonin and naringin in raw and pasteurized orange juices. The average concentration of limonin in raw juice was 0.965 ± 0.132 ppm and in pasteurized juice it was 23.26 ± 1.36 ppm. The concentration of limonin in pasteurized juice was higher than the threshold level or 6 ppm. Considering the analysis of naringin by UHPLC, the average concentration of naringin in raw juice was 137.1 ± 10.8 ppm and in pasteurized juice it was 136.6 ± 10.9 ppm. Hence the limonin is the major compound responsible for the bitterness in pasteurized juice as the concentration increased by 20 fold compared to raw juice. This reveals that “delayed bitterness” may be the main reason for the alleviation of bitterness and it accelerates with the heat treatment. Further, naringin is the minor compound as there was no significant difference in the concentration of naringin between raw juice and pasteurized juice. Naringin may not account for the bitterness even if the concentration is higher than limonin, due to the high threshold level of naringin.



Key words: bitterness, limonin, naringin

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Quantitative analysis of selected fatty acids in sweet potato (*Ipomoea batatas*) tuber flour

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Almost all foods contain different fatty acids, including saturated, mono-unsaturated, poly-unsaturated, and essential fatty acids. The amount of fatty acids varies, making it possible to change the intake of fatty acids by changing foods. Sweet potato (*Ipomoea batatas* L.) root is a tuber crop and a low cost energy source, containing 4-5% of crude fat on dry weight basis. This study reports the percentage of some selected fatty acids of boiled *Ipomoea batatas* and dried flour of sweet potato cultivars consumed by Sri Lankans. The analysis of fatty acids from sweet potato tuber flour was carried out by extracting (n-hexane: isopropanol), hydrolyzing the lipids, methylating the fatty acids, and subjecting them to the Gas Chromatography. Standard fatty acids were used for fatty acid identification. GC column- Rtx-wax & Diode array detector was used for this analysis.

Table 1: Selected fatty acids of sweet potato flour expressed as a % of fat content (W/W).

Variety (Boiled & dried flour)	Caproic acid (C6:0)	Caprylic acid (C8:0)	Capric acid (C10:0)	Lauric acid (C12:0)	Myristic acid (C14:0)	Palmitic acid (C16:0)	Stearic acid (C18:0)	Oleic acid (C18:1)	Linoleic acid (C18:2)
Ama	4.43	0.13	3.03	8.98	0.26	25.25	7.97	41.89	7.87
HordiMalee	0.02	0.06	1.82	9.56	0	29.28	8.99	44.23	6.03
CARI 9	0.02	0.17	3.74	14.42	0.47	27.20	1.43	45.7	6.87
Dhawala	0.03	0.24	2.47	13.59	0.44	25.76	10.81	38.24	8.43
Ranabima	0.26	0.38	3.11	19.07	0.47	22.19	8.79	40.10	5.63
CARI426	0.03	0.02	3.39	22.75	0.41	15.94	9.66	41.72	6.07
Gannoruwa White	0.14	0.60	2.34	22.99	3.90	26.76	10.70	26.63	5.95
Chithra	0.23	0.51	2.51	23.17	0.05	26.49	1.91	37.64	7.49
Wariyapola White	0.59	1.56	0.87	12.01	1.06	29.18	11.93	35.89	6.92
Wariyapola Red	0.63	0.11	0.80	9.48	0.37	30.76	11.03	37.82	9.01
CARI 273	0	0.15	1.56	8.00	0.52	29.45	10.26	38.88	11.48

The most abundant fatty acid found in sweet potato was oleic acid (26-46%), with all varieties except one having more than 35%, indicating that sweet potato flour is a good source of mono-unsaturated fatty acids. Other major fatty acids found in sweet potato were palmitic (15-31%) and lauric (8-23%) acids. Linoleic acid (6-12%), an essential fatty acid (omega-6) was also present in all varieties studied. Sweet potato flour is a good source of saturated fatty acid, oleic acid, and linoleic acid.

Keywords: Sweet potato, Lauric acid, Linoleic acid, Oleic acid, Palmitic acid, Stearic acid.

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***Aporosa lindleyana* Baill. (Kebella) tea: An alternative to Green tea**

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Camellia sinensis known as tea is the most consumed beverage worldwide and reported to have numerous health benefits. Compared to *Camellia sinensis*, other herbal teas are less investigated for their health benefits to date. *Aporosa lindleyana* Baill., known as *kebella* in Sinhalese, is used as a leafy vegetable in Sri Lanka. The root and bark of this plant is reported to have many bioactivities. However, leaves of this plant are scarcely investigated for pharmacological activities except the antioxidant activity by DPPH mechanism and anti-inflammatory activity. Therefore, the present study evaluated the antioxidant activity of *A. lindleyana* by multiple mechanisms, sensory properties of tea brew, and quantification of phytochemicals and proximate composition of its leaves.

Fresh *A. lindleyana* leaves were collected from Maharagama, Western Province in Sri Lanka, cleaned, oven dried at 50 °C for 6 h, powdered and sieved to obtain 0.8 mm size particles to prepare kebella tea. The tea brew of kebella (2 g in 100 mL of boiled water for 10 minutes) was used to evaluate the antioxidants in terms of total polyphenolic content (TPC, n= 6), total flavonoid content (TFC, n=6), and antioxidant properties via Ferric reducing antioxidant power (FRAP, n=6), 1,1-diphenyl-2-picrylhydrazyl (DPPH, n=4) and 2,2'-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS, n=4) antioxidant bio assays *in vitro*. The sensory evaluation (appearance, colour, mouthfeel, aroma, flavour and overall acceptability) of *A. lindleyana* tea was carried out by comparison to green tea using SLS 78: 1997 and ISO 5495: 2005 standard methods.

The mean TPC and TFC of tea brew of kebella were 875.3 ±42.0mg Gallic acid equivalents/L and 7.85±0.27 mg Quercetin equivalents/L respectively. The antioxidant activities for FRAP, DPPH and ABTS of tea brew were 1151.5 ±27.7, 899.1 ± 74.7 and 1520.3 ± 95.5mg Trolox Equivalents/L, respectively. The leaves contain alkaloids (1.4%), saponins (0.79%), steroids (0.54%), terpenoids, tannins and flavonoids. The proximate composition: moisture, carbohydrate, protein, fat, crude fibre and ash was 12.2, 49.4, 13.2, 1.1, 16.0, and 8.1% respectively. Sensory evaluation showed that green tea and kebella tea were not significantly different in terms of mouthfeel, aroma, flavour and overall acceptability. In conclusion, the tea brew of leaves of *A. lindleyana* is highly nutritious and possesses marked antioxidant activities. The kebella tea can compete with green tea in terms of major sensory parameters and it can be used as a potential nutraceutical.

Keywords: *Aporosa lindleyana*, antioxidant, sensory evaluation, proximate analysis.

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Application of fluorescence spectroscopy as a tool for quality determination of two selected ayurvedic medicinal oils.

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Preparation of Ayurvedic medicinal oils follows unique processes to preserve the medicinal quality of the oils. However, the quality of these oils may vary depending on the altered procedures used by different manufacturers, and also fake products can be found in the market. Further, due to storage conditions (temperature, light) these herbal oils tend to degrade. Therefore, determination of oil quality is of primary importance. The availability of an easy, inexpensive, and quick qualitative method is desired for initial screening of the oil quality. The quality of edible oils has been determined using fluorescence spectroscopy. Hence, this research is focused on investigating the ability to adopt fluorescence spectroscopy to determine quality of Ayurvedic oils. Ayurvedic oils, which are prepared using plant parts, contain fluorophores: polyphenols (λ_{em} 320 nm– 370 nm), tocopherols and vitamin E compounds (λ_{em} 330 nm– 600 nm), and chlorophyll pigments (λ_{em} 650 nm– 680 nm). Two Ayurvedic oils with complex composition –Nirgundyadi oil and Sarshapadi oil– were selected for the study. The quality of different brands (Brand I and Brand II) of the two selected oils was compared with reference oil obtained from the Sri Lanka Ayurvedic Drugs Corporation, which prepares oils in accordance with the Ayurvedic pharmacopeia. Also, the changes that occur in the selected reference oils upon degradation by exposure to sunlight, ultra-violet light, air, and heat were monitored. The emission wavelength and intensity were used in identifying the differences in the quality of oils under study. Obtained data were treated statistically (t-test) to identify the usefulness of fluorescence emission to evaluate the quality of Ayurvedic oils. A significant difference in emission wavelength ($P \geq 0.05$) and fluorescence intensity was observed for Brand I and Brand II of both selected Ayurvedic oils compared to the reference oils. The emission wavelengths of the reference oil samples exposed to air and sunlight were found to be same as the emission wavelength obtained for Brand I and Brand II of Nirgundyadi oil, indicating a possible adulteration in these brands. Although emission wavelength for adulterated Sarshapadi oil exposed to air and heat were different from the reference, it was not same as the values obtained for Brand I and Brand II. This study reveals the potential of fluorescence spectroscopy as a primary screening tool to determine quality of Ayurvedic oils.

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Optimization of parameters for extraction of dye from *Swietenia macrophylla* (Mahogany) and adsorption isotherms on cotton fabric

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Natural dyes extracted from plants and animals were used for coloring textiles since ancient times. The dye extracted from *Swietenia macrophylla* (Mahogany) bark, which gives an intense maroon colour, is a popular natural dye used to colour fabrics from ancient times. The objective of the present study is to optimize the parameters for extraction, such as extraction time and on weight goods ratio for extraction of natural dye from Mahogany bark and to investigate their adsorption isotherms on cotton fabric. An aqueous 1% alkaline solution was used for the extraction of the dye from the bark at 90^oC. Optimum dye extraction was obtained at 2 hours and optimum on weight goods (owg) ratio for extraction was 1:6. Cotton fabric was scoured using 4% Na₂CO₃ solution for 1 hour prior to dyeing to remove stains in the fabric. Usually a salt of Mg, Al, Fe, Cr, Cu, or Ti has to be used as the mordant to enhance the affinity of the nature dye to the fabric. In order to test the best mordant for this dye, 4% on weigh fiber (owf) solution of Al₂(SO₄)₃, MgCl₂, FeSO₄ were applied. MgCl₂ showed the best uniform dyeing, thus it was used as the optimized mordant for dyeing experiments. Adsorption of extracted mahogany dye to the cotton fabric and adsorption capacities are significantly affected by pH, initial dye concentration and the temperature of the dye bath. The dye bath was maintained at pH=10 and 90^oC for 2 hours. Metal to liquor ratio of a mordant was 1:50. Data were satisfactorily fitted to a Langmuir isotherm (R² =0.9806). According to the Langmuir model, the calculated maximum monolayer coverage capacity was 13.5318 mg/g.

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**General water quality parameters of hospital wastewater from three selected hospitals,
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Most of the hospitals in Sri Lanka discharge wastewater directly to the environment without much treatment. Hence, the objective of the study was to assess the general water quality parameters of three selected hospitals in Sri Lanka, Kandy General Hospital, Badulla General Hospital, and Diyathalawa Base Hospital, in order to understand the status of pollution via wastewater discharge. Five sampling points were selected in each hospital where the point source pollutants released (KGH-01 to KGH-05, BGH-01 to BGH-05, and DBH-01 to DBH-05). Hospital wastewater (HWW) samples were collected at regular interval for 3 consecutive months. Different physiochemical parameters were measured at the site, viz., pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), and dissolved oxygen (DO). The samples were then transported to the laboratory for the testing of total suspended solids (TSS), total solids (TS), volatile solids (VS), volatile suspended solids (VSS), biological oxygen demand (BOD₅), chemical oxygen demand (COD), chloride, nutrients (P and N), Cr(VI), and heavy metals (Ni, Zn, Pd, Mn), and also pathological contaminants (Coliform). The pH of the samples ranged from slightly acidic to highly basic; 6.3 to 9.7. BOD₅ values ranged from 20 to 1900 mg/L, the highest being reported at Kandy (however, lesser values were reported from Diyathalawa), whereas COD ranged from 150 to 1200 mg/L. The maximum nitrate concentration was <250 mg/L NO₃⁻N, while the nitrite concentration reached even up to 2.4 mg/L, indicating redox conditions. The highly toxic hexavalent chromium Cr(VI) concentration ranged well above the WHO permissible levels, ranging 0.051 mg/L - 0.225 mg/L. Heavy metals were well below the maximum tolerance limits set by Central Environmental Authority, except for Zn, which was 2-3 higher in some samples. Volatile Organic Compounds, which are considered to be carcinogenic, mutagenic and teratogenic, were reported from all hospital waste waters. Biological analysis indicated very high concentrations of total coliform and *E. coli*. The results indicate that the wastewater from these hospitals urgently needed to be treated before being discharged into the environment, since the HWW directly discharges into the water sources used for water supply.

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962/E2

Rice flour fortification with iron and the acceptability of the traditional food products made from fortified flour

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Iron deficiency anaemia is the most prevalent nutritional deficiency in Sri Lanka. The recent nutritional surveys highlighted that significant differences exist in the prevalence of anaemia in relation to geographical areas and socio-economical groups. A high proportion of anaemia was reported in the children at the age of 6-59 months (25.2%) and women, pregnant, non-pregnant, and lactating (8.3%, 33.6% and 30.2% respectively) in the estate sector. The Government needs to increase and popularize the consumption of iron fortified rice flour among the estate population, who suffer from a high rate of anaemia. The aim of the present study is to fortify rice flour, as per WHO recommendations (*i.e.*, 40 ppm of iron as a source of sodium iron EDTA and 2.6 ppm of folic acid) and to evaluate overall consumer acceptability of commonly consumed Sri Lankan traditional rice flour-based food products such as roti, string hoppers and hoppers. Mixing of mineral and vitamin premix was carried out on a pilot scale in 50 kg batch sizes, using a pilot model Gardner Ribbon blender, and physico-chemical properties of the fortified flour, iron content, and sensory evaluation of products were investigated. Results were shown that the mixing time for homogenous distribution of fortificant could be achieved after blending in a Ribbon blender for 15 min. A significantly high iron content ($p \leq 0.05$) among the products formulated from unfortified flour was obtained in roti (28.6 ppm, db) due to the addition of scraped coconut (~50%) while from fortified flour was obtained in string hoppers (63.3 ppm, db). With regard to the percent iron losses during processing of products, roti had shown a significant higher value (34.2%, on db) than string hoppers and hoppers (-3.8% and 4.3%, on db) from the original fortified flour at 40 ppm level. Roti, string hoppers and hoppers prepared from fortified flour were accepted by the screened sensory panel and processing with fortified flour has not imparted any significant ($p \leq 0.05$) organoleptic changes on products. Therefore the fortification of iron into rice flour at level of 40 ppm can be recommended for formulation of products.

Key words: Iron deficiency, iron fortification, rice flour, anaemia

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