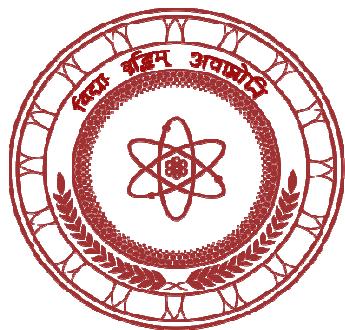


*Sri Lanka Association for the  
Advancement of Science*



Proceedings of the 72<sup>nd</sup> Annual Sessions  
5 – 9 December, 2016

**Part I: Abstracts**



## Sri Lanka Association for the Advancement of Science – 2016

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***Part I – Abstract***

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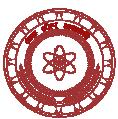
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## *Oral Presentations*



## Section A

101/A

### Acute toxicity and diuretic effect of hot water extract of *Tragia spp.* in Wistar rats

M S Pallie<sup>1\*</sup>, P K Perera<sup>1</sup>, C L Goonasekera<sup>2</sup>, K M N Kumarasinghe<sup>2</sup>, and L D A M Arawwawala<sup>3</sup>

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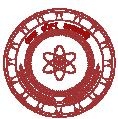
*Tragia spp.* (TS) is widely used in Sri Lankan traditional medicine for wound healing, nervous disorders, diabetes mellitus, and as a diuretic. The present study investigated the diuretic activity of the hot water extract (HWE) of TS whole plant at different doses and the acute toxic potential of the HWE at an upper fixed dose of 5000 mg/kg on adult male Wistar rats.

In the diuretic study rats were divided randomly into six groups (n=6 /group). Negative control group was fed with distilled water, and four TS groups were fed with HWE at doses of 550,1100,1650 and 2200 mg/kg, respectively. The standard group was administered with furosemide (13 mg/kg). They were kept in metabolic cages and urine was collected for five hours. Urine volume at each hour, pH, specific gravity, Na<sup>+</sup> and K<sup>+</sup> concentrations were investigated. For the acute toxicity study, a group of rats (n=6/ group) was administered HWE at a dose of 5000 mg/kg while the control group received distilled water, for 14 consecutive days. Rats were observed daily for general toxic effects such as overt signs of toxicity and moribund status or mortality. At the end of 14 days, effects on hematological parameters, serum enzyme levels, external morphology and histopathology of selected organs were studied.

The results depicted a dose dependent increase in the urine output ( $p<0.05$ ) of TS fed groups, and the furosemide administered group compared with the negative control. In the acute toxicity study, administration of the HWE of TS for 14 days did not result in acute toxic effects in terms of (a) hepatotoxicity (b) renotoxicity (c) haematotoxicity (d) gross morphology and weights of organs, (e) stress and aversive behavior. In conclusion, the study confirmed the presence of diuretic activity in HWE of whole plant of TS in adult male Wistar rats, and the absence of acute toxicity at an upper fixed dose of 5000 mg/kg.

Keywords: *Tragia spp.*, acute toxicity, diuretic activity, Wistar rats

Acknowledgement: Financial assistance by the UGC Research grant UGC/ DRIC/ PG/ 2014MAY/IIM/01.



102/A

**Diagnosis of suspected cutaneous leishmaniasis lesions with rapid diagnostic test and slit skin smear: a comparative study**

L D G G De Silva<sup>1\*</sup>, V Somaratne<sup>2</sup>, S Senaratne<sup>1</sup>, M Vipuladasa<sup>2</sup>, S Ranasinghe<sup>1</sup> and R Wickremasinghe<sup>1</sup>

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Cutaneous leishmaniasis (CL), a neglected vector borne tropical infection which causes non-healing skin lesions, is a newly emerged and established disease in Sri Lanka. The main diagnostic technique available for leishmaniasis is skin slit smears (SSS) which is less costly and most commonly used method in laboratories to identify Leishmania amastigotes (LD bodies), which has the reported sensitivity between 35-60%. Since this does not warrant adequate accuracy for the detection of the disease, the aim of this study was to compare the sensitivity and the specificity of a newly introduced commercially available Rapid Diagnosis Test (RDT) to detect Leishmania antigen in CL lesions with SSS.

Following written informed consent, eighty seven patients with clinically suggestive CL lesions were subjected to parasitological investigations. Slit skin smear was performed in duplicate for all the 87 suspected cases. Parasite count of SSS was obtained in different clinical manifestations in accordance with the WHO grading by double blind method.

In SSS, 49 (56.32%) were positive for LD bodies in suspected CL lesions. RDT were positive only on 24 lesions (27.58%). Most of the samples that were positive by RDT had a parasite count of  $\geq 2+$ , which may suggest that patients with less than  $\leq 2+$  parasitemia may not be detectable by the RDT. These results indicate that the sensitivity of RDT was only 48.9%. This study implies that RDT is positive only with a high parasite count and therefore cannot be recommended to be used to diagnose leishmaniasis in Sri Lanka in patients with a low parasitaemia.

**Keywords:** Cutaneous leishmaniasis, skin slit smears, Rapid Diagnostic Test (RDT)

**Acknowledgement:** Grants ASP/06/RE/2013/37 and ASP/06/RE/MED/2012/30 of the University of Sri Jayewardenepura.



103/A

**Effectiveness of active malaria surveillance amongst in-ward patients in the phase of prevention of reintroduction of malaria to Sri Lanka**

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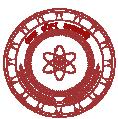
Malaria has been eliminated from Sri Lanka but imported malaria cases continue to be reported. This study was carried out over 14 months in four teaching hospitals in the Western Province (which recorded the highest number of malaria cases over the past three years) to determine the feasibility and usefulness for the Anti Malaria Campaign (AMC) to carry out active case detection (ACD) in hospitals amongst persons presented with risk factors for malaria.

As Health Care Providers (HCPs) often fail to consider malaria in the differential diagnosis of fever, resulting in delayed diagnosis, routine malaria surveillance practices amongst HCPs were also observed. Thirty four (34) Medical wards in these four hospitals were randomly divided into A (n=18) and B (n=16) groups. Group A wards were visited daily and 3238 febrile patients with risk factors for malaria were tested by microscopy and Rapid Diagnostic Test.

No one tested positive for malaria by ACD. Malaria was suspected in the differential diagnosis by HCPs in 7.16% of febrile persons with risk factors of malaria and recorded in the BHT in 1.45%. There were 214 malaria diagnostic tests requested by HCPs from Group A, and 194 tests requested from group B wards which were only passively observed during the study period. Among 169,772 patients admitted to the 34 medical wards, seven malaria cases were identified, 3 in Group A and 4 in Group B wards. These cases were notified verbally to the AMC but only four were entered into the notification register by the ward staff. Three of these patients were admitted to hospital after diagnosis of malaria made outside, and 4 were diagnosed by the routine hospital system, independent of the ACD system. Of these 4, two were detected accidentally during blood examination and not because of a request for malaria testing by the ward. The results suggest that active screening of hospital wards for malaria is not warranted, but that a greater effort should be made to improve the awareness of HCPs on the importance of suspecting and requesting testing for malaria, and on the need for reporting malaria cases to the AMC.

**Keywords:** malaria, re introduction, malaria surveillance

**Acknowledgment:** National Science Foundation (Grant No: RG/2014/HS/03)



104/A

**Receptivity for malaria transmission in a highly vulnerable district: A potential challenge for prevention of reintroduction efforts in Sri Lanka**

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Sri Lanka has eliminated indigenous malaria cases since October 2012. Currently, the biggest threat to the elimination efforts is the risk of resurgence due to imported malaria. In 2012 there were 70 imported malaria cases, followed by 95, 49 and 36 in 2013, 2014 and 2015, respectively. The majority of these cases were reported from the Western Province, having risen from 62.1% in 2013 to 65.3% and 66.7% in 2014 and 2015, respectively. In this backdrop in the Western Province, receptivity to malaria, which persists due to high abundance of primary and secondary vectors, is a parameter critical for decision making. The current study was designed to assess the receptivity to malaria in the Gampaha District, which recorded 38.9%, 30.6% and 27.7% of the total reported cases in 2013, 2014 and 2015, respectively.

The assessment was done by collecting information on critical entomological parameters such as vector larval abundance, man biting and indoor resting behavior of malaria vectors that contribute significantly to determine receptivity to malaria. Possible breeding sites of Anopheles mosquitoes were surveyed and indoor resting and human biting malaria vectors were sampled from March 2015 to April 2016 in four localities of Meerigama MOH area of the Gampaha District.

A total of 1656 Anopheles larvae of 14 species were collected from 22 breeding sites. The major malaria vector Anopheles culicifacies was found in rock pools (98.7%) followed by river margins (1.3%) of Ma oya river. During the surveys, outdoor human biting A. culicifacies were found in the months of January (0.2 per bait per hour) and March (0.08 per bait per hour) 2016, while indoor resting A. culicifacies (0.04 per man hour) were found in February 2016. This preliminary report records the present status of malaria receptivity in the study sites with an increase of receptivity observed from January to March 2016. An increase of receptivity coupled with vulnerability in the Western province could pose a significant challenge to the malaria free status in the country. Strengthening of entomological surveillance in the Western Province along with high level of vigilance would be critical for maintenance of malaria free status of the country.

**Keywords:** Malaria transmission, entomological surveillance

**Acknowledgement:** Financial assistance by the AMC and the Open University of Sri Lanka research grant OU/201402

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105/A

**Monitoring the prevalence of Aedes aegypti (L) and Aedes albopictus (Skuse) in Colombo city using BioGent-Sentinel traps and ovitraps**

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Monitoring density of vector populations is crucial in controlling dengue since it serves as a proxy indicator of the risk of dengue transmission. Number of dengue vectors, Aedes aegypti and Ae.albopictus can fluctuate over time in response to environmental conditions. Adult traps and ovitraps are potential tools which can supplement the existing methods for monitoring dengue vector populations.

Adult Aedes populations were monitored in Narahenpita, Thimbirigasyaya and Kirula Public Health Inspector (PHI) areas in Colombo Municipal Council Area from October 2015 to May 2016 using BioGent-Sentinel (BG-S) traps (Biogents AG, Germany) with BG-sweetscent™ attractant which consists of substances found in human skin. These were set up inside 8 -10 houses. Collections made every week were identified under stereo microscopy based on their morphology. Ovitraps were placed outdoors (n=49-60), but within close proximity to the houses (<2m) in the same study area during the above period and monitored weekly. The eggs were transported to the laboratory and larvae were identified when hatched. The percentage of positive traps was calculated for both types of traps. The mean number of adults and eggs of Ae.aegypti and Ae. albopictus per trap were calculated for BG-S traps and ovitraps, respectively.

The results obtained from BG-S traps and ovitraps indicated that Ae. aegypti is the predominant species in the study area with a low presence of Ae. albopictus. The mean % of positive BG-S traps for Ae.aegypti and Ae. albopictus were  $43.18 \pm 15.64$  SDV and  $5.31 \pm 8.29$  SDV, respectively. The mean number of adults (males and females) per trap for BG-S was  $1.03 \pm 0.61$  SDV for Ae. aegypti and  $0.11 \pm 0.19$  SDV for Ae. albopictus. For ovitraps the mean % of positive traps for Ae. aegyptiand Ae. albopictus were  $7.96 \pm 3.78$  SDV and ,  $2.93 \pm 2.71$  SDV, respectively. The mean number of eggs of Ae. aegypti per ovitrap was  $4.97 \pm 3.17$  SDV and for Ae. albopictus  $1.67 \pm 1.78$  SDV. The results indicated that Ae. aegypti is the predominant vector in PHI areas studied in Colombo Municipal Council and both BG-S and ovitraps can be used as vector surveillance methods for dengue in highly urbanized areas.

**Keywords:** Ovitraps, BioGent- Sentinel traps, Ae. aegypti, Ae. albopictus

**Acknowledgement:** Financial assistance by International Atomic Energy Agency (IAEA RAS 5066) and National Research Council (NRC TO 14/04)



106/A

**Phyllanthus debilis Klein ex willd root extract induces apoptosis mediated cell death in cultured rhabdomyosarcoma cells**

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Cancer is a leading disease in the world. *Phyllanthus debilis* Klein ex Willd (Elapitawakka) has many medicinal values. The present investigation evaluated the cytotoxic effect of roots of *P. debilis* plant against rhabdomyosarcoma (RD) cells.

Roots of the matured plants were refluxed with deionized water and lyophilized. Root extract at different concentrations was exposed to RD cells for 24 hours. The protein content and reduced glutathione (GSH) levels in the cell lysate were determined to evaluate the dose dependent cytotoxicity and cellular antioxidant level, respectively. Caspase 3 and DNA fragmentation assays were carried out to evaluate the mechanism of induction of apoptosis and cell death pathway. Negative control in the absence of the extract and cycloheximide as the positive control were used simultaneously.

Protein content decreased reciprocally with the concentration and the EC<sub>50</sub> value was 392.5 ± 13.9 µg/mL (n=3). Decrease in GSH levels (0-1000 µg/mL) and increase in Caspase 3 activity (0- 1000µg/mL) was observed in a concentration dependent manner. DNA ladder pattern of the fragmented nuclei characteristic of apoptosis was detected at concentrations > 200 µg/mL. The results indicate a moderate cytotoxicity on RD cells by the plant extract. Reduced cellular antioxidant potential caused by depletion of GSH can be proposed as the possible mechanism to induce caspase 3 activity leading to DNA fragmentation and cell death.

**Keywords:** Cytotoxicity, apoptosis, DNA fragmentation, caspase 3, glutathione (GSH)

**Acknowledgement:** Financial assistance by the University of Colombo Research Grant AP/3/2/2014/RG11



107/A

**Modeling and in silico analysis of the impact of eight missense mutations on human growth hormone activity using a novel approach**

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Human growth hormone (hGH) plays a determinant role in growth and development of the human body during early stages of life. Harmful missense mutations of GH1 gene can give rise to a deficient hGH which is a recognized cause of short stature. It is crucial to understand the underlying molecular mechanisms to assign pathogenicity to missense mutations. However, most reported mutations of GH1 lack annotations. Not all missense mutations are deleterious; some are neutral; hence in vitro assays to initially characterize them would be a waste of resources while computational/theoretical approaches provide relatively accurate information readily with lesser cost. Here we performed a comprehensive analysis on eight missense mutations of GH1 (D112G, C53F, C53S, R77C, R183H, R16C, R16L, C189Y) to examine their impact on hGH activity using in silico analysis tools.

In this study, we developed a "successive relaxations" approach, starting from a zero-speculation initial model and incrementally adding more information in successive steps. X-ray structures were used to build homology models of hGH mutants using MODELLER and refined by molecular dynamics refinement protocol. UCSF Chimera was used for pre-processing, visualization and analysis. Our approach was validated by modeling an experimentally known mutant (G120R). L9P, M14S, V110I inert mutants were used as reference controls.

Comparing each mutant with the wild type and putative controls, we suggested a decrease in receptor activation by hGH<sub>D112G</sub>. The effectiveness of signal transduction was affected due to changes in the interaction with the receptors by hGH<sub>C53F</sub> due to its decreased stability; hGH<sub>R77C</sub>, by modifying the orientation of its receptor interaction; hGH<sub>R16L</sub> and hGH<sub>C189Y</sub>, by weakening the interaction. hGH<sub>C53S</sub> likely resulted in a bio-inactive complex. Effect of hGH<sub>R183H</sub> and hGH<sub>R16C</sub> on hGH bioactivity was predicted to be small and similar to wild type hGH. This is the first in-depth modeling study of hGH mutations that has included controls to evaluate the results, that looks at the potential effects of mutations in bound/unbound confirmations including the interactions with the receptor and within receptor subunits. Our approach produced plausible explanations in good agreement with experiment in all cases where data was available, thus supporting the applicability of this approach to understanding mutations of hGH.

**Keywords:** missense mutations, in silico analysis tools, human growth hormone



108/A

**Seasonal pattern and risk factors of human otoacariasis in the Kandy District, Sri Lanka**

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Tick's site of attachment on the human body varies, but of particular interest is the lodging of ticks within the ear canal, a condition known as otoacariasis. Seasonal pattern and risk factors of human otoacariasis in the Kandy District were studied from December, 2013 to November, 2014.

Ticks collected from patients attending the Ear, Nose and Throat clinic in the Kandy General Hospital (KGH), were preserved and identified. A case control patient follow-up study was carried out in the Kandy District to assess the risk factors. Risk factor analysis was carried out visiting 47 patients and three different controls per case (n= 141).

Of the 66 cases reported to KGH, a majority was infested with nymphal stages of *Dermacentor auratus* (90.8%) followed by *Amblyomma integrum* (4.6%) and *Hyalomma isaaci* (3.1%). The highest number of cases was reported from December to February coinciding with the rainy period and a smaller peak in October. Most of the patients were from Thalathuoya followed by Ampitiya, Menikhinna and Poojapitiya. Two risk groups identified were: females (80.0%;  $\chi^2 = 18.41$ , p< 0.001) and children (< 10 years; 56.9%;  $\chi^2 = 95.24$ , p<0.001). Presence of domestic animals (85.1%;  $\chi^2=34.28$ , p<0.001), association with wildlife (91.5%;  $\chi^2 = 35.94$ , p<0.001) and engagement in outdoor activities (97.9%;  $\chi^2 = 20.27$ , p<0.001) were identified as risk factors. Children and women become risk groups as they were more engaged in outdoor activities such as playing, gardening, tending to vegetable plots, etc. In the Kandy District the villagers often interact with forest gardens (Kandyan Forest Gardens) nearby. This increases the exposure to questing ticks on vegetation. The immature ticks could attach to the person after dropping or after climbing on to the host from a questing position on low vegetation. The adult stage of the major tick species associated with otoacariasis, *D. auratus* infests wild boars, a common visitor to home gardens in the Kandy District and the larvae of *D. auratus* had been recorded on dogs. Although the presence of a home garden was not identified as a risk factor, involvement in outdoor activities in these gardens posed a risk.

**Key words:** human otoacariasis, ticks, *Dermacentor auratus*, Kandy district

**Acknowledgement:** Financial assistance by the National Research Council (Grant No. 11-44), Sri Lanka.



## Section B

201/B

### Changes in physiochemical properties of deep fried food due to use of repeatedly heated coconut oil

A J N Gimasha<sup>2</sup>, L L W C Yalegama<sup>1\*</sup>, H A E Samaranayake<sup>1</sup>and K D P PGunathilake<sup>2</sup>

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The physical, chemical and sensory properties of food can change during deep frying when oil tends to be used repeatedly for frying. To investigate chemical and physical changes of deep fried food due to use of oil repeatedly for deep frying, coconut oil was subjected to deep frying of potato chips, dhal, and salaya fish (gold-stripe sardinella). Six frying cycles were undertaken for each type of food. After each cycle of frying, food was analyzed for moisture content, free fatty acid level (FFA) and peroxide value. Moisture content of potato chips, dhal and salaya fish changed between 17.5 % - 21.8 %, 17.5% - 32.3% and 14.3% -32.2%, respectively during 6 frying cycles. Repeated heated of oil for frying did not much affect on the FFA value of potatoes. However, the FFA values of dhal (0.12%-1.9%) and fish (1.0%-4.3%) showed comparatively high FFA contents. The peroxide value of fish increased with repeated use of frying oil and it was 3 times higher on the 6<sup>th</sup> day (5.7 meq/kg) compared to the 1<sup>st</sup> day (1.8 meq/kg) whereas peroxide values of dhal and potato increased gradually (less than 2 meq/kg). In conclusion, repeated heating of coconut oil for frying influence on the chemical properties of food, depending on the type of food.

Keywords: Coconut oil, free fatty acid, peroxide value, repeated frying



202/B

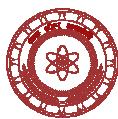
**Estimation of embedded energy of vegetables from the farm to the Dambulla Economic Center**

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Energy is accumulated in vegetables at all stages of the value chain from farm to plate. Investigation of embedded energy in the value chains of vegetables is important for the energy security of the country. Thus six vegetable types were purposely selected based on the highest annual production in Sri Lanka and its embedded energy was estimated tracing the value chain of vegetables from the farm to the Dambulla Economic Center (DEC) through a pretested questionnaire administered to the farmers and collectors at DEC. For the selected vegetables 655 MJ/acre of fossil fuel had been used for land preparation, 2605 MJ/acre for water pumping and 122 MJ/acre for pesticide application in the farm and 3383 MJ of fossil fuel had been used for the transportation of vegetables to the DEC. Highest amount of energy was embedded in beetroot followed by beans. The least amount of energy was embedded in brinjal and okra. According to the results it can be concluded that for the selected vegetables the highest amount of energy was embedded in water pumping and for transportation of vegetables to the DEC.

**Keywords:** Embedded energy, water pumping, vegetable production, Sri Lanka



203/B

**Issues in food handling practices and hygienic conditions of restaurants located within the area of the Colombo Municipal Council, Sri Lanka**

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Food borne disease outbreaks have been identified as one of the major problems in developing countries. The risk of occurrence of food borne illnesses is high with the foods served in restaurants. The main objective of this study was to identify the current food handling practices and hygienic conditions of restaurants located in the area of the Colombo Municipal Council. Data were collected from 225 restaurants. Selection of restaurants was based on the stratified random sampling technique. The sample included small and medium scale fast food restaurants which had kitchens for preparing food. Face to face interviews with the employees and an observation check list were used to collect data. Results showed that approximately 75% of the restaurants had unsatisfactory levels of storage conditions, personal hygiene and food preparation practices. More than 60% of the restaurants showed cross contaminations and unsatisfactory levels of temperature control in food processing, waste disposal procedures, pests and rodent control, and hygienic conditions. Reasons for above unsatisfactory levels on food handling practices and hygienic conditions were identified as poor knowledge (87%) and attitude of the employees on food hygiene and lack of interest shown by the owners of restaurants. Moreover, lack of space in kitchens and high costs involved with the implementation of hygienic facilities in the restaurants were the other reasons. The study concluded that 76% of the sample restaurants in the Colombo Municipal Council area had unsatisfactory food handling practices, which could lead to a high risk in the occurrence of food borne illnesses.

**Keywords:** Food, restaurants, food processing, hygiene, food borne illnesses



204/B

**Antioxidant capacity and bioactive compounds of selected herbal tea blends produced in Sri Lanka**

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Tea (*Camellia sinensis* L.), the second most commonly consumed beverage in the world is a rich source of flavonoids. Green tea, the unfermented tea contains mainly catechins whereas black tea, mainly contains thearubigins (TR) and theaflavins (TF) due to fermentation. Before the introduction of tea to Sri Lanka some medicinal herbs which contained phenolic compounds and antioxidant properties were used extensively as beverages. Phenolics are secondary plant metabolites mainly found in medicinal herbs and teas. Recently the blends of tea with medicinal herbs have become popular as value added products worldwide. This study was conducted to determine antioxidant capacity and bioactive compounds (phenolics and flavonoids) of some selected popular herbal tea blends produced in Sri Lanka.

Aqueous extracts of 8 herbal tea blends (viz. Ranawara+Gunpowder, Beli-mal+Gunpowder, Kowakka+Gunpowder, Polpala+Gunpowder, Gotukola+BOP, Karapincha+BOP, Iramusu+BOP and Koththamalli+BOP) were analyzed for total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC). TAC was determined by Ferric reducing antioxidant power (FRAP) assay. Colorimetric methods were used to quantify total phenolics (Folin-Ciocalteu method) and total flavonoids.

Higher TAC was observed in green tea herbal blends than black tea herbal blends. Beli-mal+Gunpowder blend showed the highest TAC ( $80.3 \pm 0.1$  mg TE/g DW) TPC ( $34.6 \pm 0.1$  mg GAE/g DW) and TFC ( $9.5 \pm 0.1$  mg RE/g DW) among selected green tea herbal blends whereas lowest TAC, TPC and TFC were recorded in Kowakka+Gunpowder blend. Iramusu+BOP blend had a higher TAC ( $41.8 \pm 0.3$  mg TE/g DW), TPC ( $25.3 \pm 0.6$  mg GAE/g DW) and TFC ( $11.7 \pm 0.4$  mg RE/g DW) while, the lowest was observed for Koththamalli+BOP blend. A strong significant correlation was observed between total antioxidant capacity and total phenolic content ( $R^2 = 0.90$ ,  $p < 0.001$ ). The total flavonoids also showed a good positive correlation ( $R^2 = 0.53$ ,  $p < 0.001$ ) with total antioxidant capacity. The existing positive and significant correlations between total antioxidant capacity and phenolic compounds revealed that phenolic compounds were the dominant antioxidant components in herbal tea blends. Herbal tea blends, polyphenolic beverages, may play an important role as a source of naturally occurring antioxidants.

**Keywords:** Antioxidant capacity, flavonoids, phenolics, herbal tea



205/B

**Prey preference of *Coccinella transversalis* Fabricus (Coleoptera: Coccinellidae) on three aphid species: *Aphis crassivora*, *Toxoptera citricida* and *Aphis gossipi***

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Aphids are one of the most destructive pests and both the adults and nymphs damage flowers, buds, pods, tender shoots and reduce the market value of the product. Presently, biological control is used as a major management method for aphid pest control. Coccinellids (Coleoptera: Coccinellidae) are the most important insect predators of aphids (Hemiptera: Aphididae); among the coccinellids, *C. transversalis* is one of the most efficient predators of aphids. Therefore, it is important to find the most effective prey aphid insects for the mass rearing of *C. transversalis* under laboratory conditions.

*C. transversalis* adults were collected from natural unsprayed vegetable fields and reared in the laboratory by providing three different types of aphids, namely *Aphis craccivora* (T1:black bean aphid), *Toxoptera citricida* (T2:citrus aphid) and *Aphis gossipi* (T3:cotton aphids) separately. Male and female compatible pairs of *C. transversalis* reared on the three different types of aphids were taken separately and kept for one day for mating. After eggs were hatched, first instar larvae were fed with 100 adults of *A. craccivora*, *A. gossipi* and *T. citricida* separately. Same experiment was repeated with second instar, third instar, and fourth instar larvae and for the emerged adults, respectively. Average daily consumption rate was measured with all larval instars and for the adults separately fed with T1, T2 and T3. CRD was applied with 3 treatment and 5 replications. The treatment means were analyzed using ANOVA and the means were compared using DNMRT.

Treatment effects were significant at alpha level 0.01 for both adults and larvae with the three different aphid species. The relative average daily consumption rate of first, second, third and fourth instar larvae of *C. transversalis* was significantly different on *A. craccivora* (38.41, 54.05, 68.21 and 86.76), followed by *T. citricida* (15.61, 32.91, 46.25 and 68.32) and *A. gossipi* (28.52, 47.04, 68.2 and 75.34), respectively. Similarly, relative average daily consumption rate of adult *C. transversalis* was significantly different on *A. craccivora* (55.04), followed by *T. citricida* (31) and *A. gossipi* (42) respectively. The prey preference of larvae and adult *C. transversalis* on adult of *A. craccivora* was significantly higher when compared with *T. citricida* and *A. gossipi*.

**Keywords:** *Coccinella transversalis*, *Aphis gossipi*, *Toxoptera citricida*, *Aphis craccivora*, mass rearing



206/B

**Bioactive phytochemical distribution in different parts and leaf positions of Pimenta dioica (L.) Merr. (Myrtaceae)**

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*Pimenta dioica* (L.) Merr. (Myrtaceae) is an evergreen aromatic spice widely used in perfumery, food and the cosmetic industry in many parts of the world. The present study compared total antioxidant capacity (TAC), total phenolic content (TPC), total flavonoid content (TFC), leaf area (LA), and fresh to dry weight ratio of *P. dioica* leaves at different maturity stages (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> leaf positions) and different plant parts (immature leaf, mature leaf and bark). The TAC, TPC and TFC were determined using Ferric Reducing Antioxidant Power Assay (FRAP), modified Folin-Ciocalteu method and a calorimetric method, respectively. Significantly high TAC 562.38±9.42 (mg TE/g DW) and TPC 279.53±7.02 (mg GAE/g DW) were detected in leaf extract obtained from the 1st leaf position. However the highest TFC 303.48±8.87 (mg RE/g DW) was detected in the 5<sup>th</sup> leaf position. According to the phytochemical distribution pattern, significantly higher TAC [619.84±11.98 (mg TE/g DW)], TPC [267.53±5.03 (mg GAE/g DW)], TFC [305.48±8.87 (mg RE/g DW)] were observed in extracts obtained from the bud region. A strong relationship between TAC and TPC in different plant parts of *P. dioica* was observed ( $R^2 = 0.9462$ ). Order of decreased leaf area was 4<sup>th</sup>> 5<sup>th</sup>>3<sup>rd</sup>>2<sup>nd</sup>>1<sup>st</sup> leaf. The decrease in leaf area after the 5<sup>th</sup> leaf is due to senescence. According to the fresh weight:dry weight ratio, the highest and the lowest values were observed for the 5<sup>th</sup> leaf and the 1<sup>st</sup> leaf positions, due to high amount of moisture content. Further, harvesting of immature leaves and bud portions could be suggested for better therapeutic benefits.

**Keywords:** *Pimenta dioica*, total antioxidant capacity, total flavonoid content, total phenolic content



207/B

**Evaluation of insecticidal activity of Sri Lankan *Bacillus thuringiensis kurstaki* against *Plutella xylostella* and *Cnaphalocrocis medinalis***

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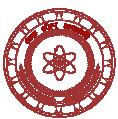
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*Bacillus thuringiensis* (Bt) is a naturally occurring gram positive *Bacillus* that produces insecticidal crystal proteins which are toxic to different insect orders of Lepidoptera, Coleoptera and Diptera. Hence, it is used worldwide for pest management applications. *Plutella xylostella* (L.) (Diamondback moth) is a key pest of crucifers worldwide. *Cnaphalocrocis medinalis* is the deadliest pest of rice, posing a permanent threat to rice cultivation. The objective of the current study was to evaluate the insecticidal activity of Bt kurstaki (Btk) against *P. xylostella* and *C. medinalis* under laboratory conditions. Btk from the Industrial Technology Institute culture collection was used in this study. Btk was cultured in a molasses based medium using a fermentor under optimal culture conditions (pH=7, agitation 300 rpm, Temperature 30 °C) for 30 hours. Resultant culture was centrifuged at 6000 rpm for 10 min at 4 °C and pellet was freeze dried to obtain Bt primary powder. Colony forming units (CFU) were calculated for the obtained Bt powder. Adult *P. xylostella* were collected from cabbage fields in Kandy and reared in an insectary at Horticultural Crop Research and Development Institute, to obtain larvae under optimal growth conditions. Larvae of *C. medinalis* were collected from fields at the Rice Research and Development Institute. Leaf dip bioassay was performed to evaluate the insecticidal activity of Btk against *P. xylostella* and *C. medinalis* larvae. Tested spore suspension of Btk was prepared by dissolving Bt primary powder in 10 mL of sterile distilled water and preparing a 10 fold dilution series for testing. Fresh cabbage leaves and rice leaves were given as food for larvae every day. Larval mortality was recorded every 24 h until 100% mortality or pupation was observed. Abbottos formula was used to correct mortality. Lethal concentration ( $LC_{50}$ ) was calculated using probit analysis for the data collected at 72 h after exposure. Percentage mortality of both *P. xylostella* and *C. medinalis* increased with time and spore concentration. Btk showed insecticidal activity having,  $LC_{50} = 3.34 \times 10^8$  spore/mL against *C. medinalis* and  $LC_{50} = 1.76 \times 10^7$  spores/mL against *P. xylostella*. Mortality data showed that Btk was more toxic to *C. medinalis* than to *P. xylostella*. It was concluded that this native strain of Bt could be used as an effective bio-control agent against *C. medinalis* and *P. xylostella*.

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208/B

**Impact on disease and pond management options in shrimp farms during heavy rains and floods**

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Proper water quality management is essential for successful and quality shrimp production. Maintaining a good culture environment through use of proper management practices will reduce the risk of disease and increase production, shrimp quality and marketability. During December 2015 to January 2016, the area between Deduruoya estuary and Mundel lagoon (Udappu) was flushed out by the North-East monsoon causing considerable damage to shrimp farms. During this period, many farmers reported signs of disease in their culture ponds. Consequently, most farms immediately harvested at lower average weight (approximately 17-20 g).

Our study was aimed at analyzing the effects of heavy rains on water quality fluctuations leading to epidemics together with management options adopted by the farmers. Initially, the water quality parameters of selected ponds, and water source and counts of total bacteria and Vibrio sp. were analyzed. Finally, white spot syndrome virus (WSSV) was checked through PCR analysis. The results showed that direct flood and retention of flood water in lagoons had resulted in extremely low salinity (0-3 ppt), resulting in unusually low salinity in ponds (2-8 ppt) for 2-5 weeks. Concentrations of ammonia ( $0.20 \pm 0.05$  mg/l) and nitrite ( $0.07 \pm 0.03$  mg/l) were at suboptimal levels in culture ponds during this rainy season. This may be due to high mixing of bottom sediments, releasing ammonia and low water exchange due to suboptimal conditions in the water source. Dissolved oxygen values were also low ( $2.26 \pm 1.54$  ppm) as observed between 10.00 am and 3.00 pm; but pH remained within optimal range (7.5-9.0). The number of total bacteria was high in comparison to the count of Vibrio sp. However, all samples analysed were negative for the WSSV. Although some farmers used probiotics for disease prevention and water quality management there was no significant difference between farmers using such options and those who did not.

Our results elucidated that there was no white spot disease (WSD) outbreak during this particular weather condition. Reasons for the signs of disease observed which were similar to WSD may have been caused as a result of stress due to unfavorable salinity, ammonia and nitrite in the water. Therefore, it is essential to implement and follow good water quality management practices during such a sensitive weather condition in order to harvest the maximum average weight and to ensure shrimp quality.

**Keywords:** Water quality management, shrimp disease, shrimp quality, rain impact



209/B

**Physical and chemical properties of gelatine extracted from the skin of scavenger fish  
(*Pterygoplichthys spp.*)**

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The scavenger fish (*Pterygoplichthys spp.*) is an invasive species which has a significant impact on commercial fishery in reservoirs due to its higher population and low consumer acceptability. If a potential use of this species could be examined, this negative impact would be minimized on inland fisheries. Since there is an increasing demand for non-mammalian gelatine, this study was carried out to extract gelatine from the skin of the scavenger fish and to characterize the gelatine according to its physical and chemical properties.

For the extraction of gelatine the fresh skin was initially treated with 0.23% (weight (w)/volume (v)) sodium hydroxide with a ratio of 1:10 (biomass (b)/v) followed by 0.2% (w/v) sulphuric acid with a ratio of 1: 6 (b/v) and then 1% (w/v) citric acid with a ratio of 1:3 (b/v). Each treatment was carried out for 2 h. Following each treatment the skin was washed with water. Then the skin was heated at 54 °C with water (1:5 (b/v)) for 12h to extract the gelatine into the solution. The solution was filtered and the filtrate was dried in an oven at 60 °C until a thin dried layer of gelatine was obtained. The average yield of gelatine from fish skin was  $4.22 \pm 0.39\%$ . The proximate composition of the extracted gelatine showed  $83.16 \pm 2.08\%$  protein,  $2.97 \pm 2.04\%$  fat, and  $6.52 \pm 2.66\%$  ash on wet basis. The pH of the gelatine was  $5.40 \pm 0.01$  and the isoelectric point was 7.0 - 9.0; therefore it can be considered as type A gelatine. Fat binding capacity of extracted gelatine was  $182.86 \pm 2.03\%$  and water holding capacity was  $12.39 \pm 0.23$  mL/g. The gelling temperature, melting temperature and melting points of extracted gelatine were  $12.5 \pm 0.5$  °C,  $25.83 \pm 0.29$  °C, and  $26 \pm 1$  °C, respectively. The results obtained in this study suggested scavenger fish skin as a prospective source for gelatine production and the possibility of using extracted gelatine in different food applications in the food industry.

**Keywords:** Acid base extraction, Fish gelatine, isoelectric point, scavenger fish skin, Type A gelatine



210/B

**Screening of different parts and leaf positions of Stevia rebaudiana (Bertoni) Bertoni for phytochemicals and antioxidant potential**

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Stevia rebaudiana (Bertoni) Bertoni (Asteraceae) is a small perennial herb which is widely grown for its sweet leaves and possesses 250-300 times the sweetness of sugar due to the presence of steviol glycosides (mainly stevioside and rebaudioside). Further, it is commonly known as candy leaf, sweet leaf and sugar leaf. Moreover, the sweetening property of stevia is also known for its therapeutic properties including antidiabetic, antimicrobial, antiviral, antifungal, anti-hypertensive, anti-tumour, anti-human rota-virus activities, anti-HIV, hepatoprotective and immune-modulatory effects. However, studies on the presence of therapeutically important active components in stevia are scarce or lacking. Therefore, the present study was undertaken to determine the total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC) of different parts of the plant and different leaf positions of S. rebaudiana. Leaf fresh weight, dry weight and leaf area at different leaf positions were recorded. The TAC, TPC and TFC were determined using Ferric Reducing Antioxidant Power Assay (FRAP), modified Folin-Ciocalteu colorimetric method and a colorimetric method, respectively. Leaf fresh weight and leaf dry weight increased with maturity. Further, all tested parts demonstrated in increasing order the TPC, TFC and TAC to be leaf>flower>stem> branch > root. TPC, TFC and TAC of different leaf positions revealed that TAC decreased gradually from immature to mature leaf (1<sup>st</sup> leaf > 2<sup>nd</sup> leaf > 3<sup>rd</sup> leaf > 4<sup>th</sup> leaf > 5<sup>th</sup> leaf). Further, all tested phytochemicals (TPC, TFC) and TAC were significantly higher in extracts prepared from the first leaf. The results of the present study are important in harvesting and quality control aspects of S. rebaudiana.

**Keywords:** Stevia rebaudiana, total antioxidant capacity, total flavonoid content, total phenolic content.



## Section C

301/C

### Groundwater management in sand dune areas of the Kayts Island with the aid of laterals

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Kayts is one of several islands which lie off the western end of the Jaffna Peninsula in the northern-most part of Sri Lanka. A thin fresh water lens is present in the sand dune area on Kayts, which occupies a small area of the western south part of the island. The low salinity groundwater lens that constitutes the Kayts aquifer system is the only promising source of fresh water. Increased risk of seawater intrusion and upconing from unsustainably high extraction rates due to increase in land development and projected population growth in this region has raised concerns for the quantity and quality of groundwater available for drinking and agriculture. Hence development of a groundwater management strategy is essential for the sustainable management of groundwater resources. A vital part of this strategy will be to ensure that management actions do not adversely affect the quality of the groundwater if sustainability in terms of quantity as well as quality is to be achieved. A numerical groundwater flow and transport model was developed as part of the investigation to assist in the analysis of freshwater and saltwater flow for current and increased pumping under various recharge scenarios. The model results reveal that the water quality is beyond the permissible salinity limit in most parts of Kayts. Particularly at the end of the dry season a narrow stretch of freshwater lens is available only in the sand dune areas. In the model study point extraction from four wells located in this sand dune area resulted in upconing of the saline interface and increased salinity levels beyond 3200 mg/L. In order to find out a method of pumping for sustainable groundwater extraction in this region and to avoid sea water intrusion due to excessive pumping rate, it was decided to introduce bottom sealed pumping wells with laterals which can yield more fresh water to the pumping wells and it was examined in the model to ascertain the effect of this type of extraction on water levels and salinity. There was no notable upconing effect which clearly indicated that this extraction methodology and pattern is sustainable.



302/C

**Defining sustainable limits to surface water storage development in river basins**

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Storage of water is widely regarded as a form of insurance against rainfall variability. Current rainfall variability is expected to exacerbate with anthropogenic climatic changes resulting in increased frequency of floods and droughts. Consequently, storage of water will continue to remain a key intervention in guaranteeing an adequate supply of water as well as detaining excess flood water. Out of the many diverse options available for water storage, historically, the “natural” first choice among water planners and managers has been surface storage development. This is evidenced by the ancient tank irrigation systems that existed in Sri Lanka from around 300 B.C. as well as multiple large dams that were constructed all over the world, during the latter half of the twentieth century. It is likely that impounding surface water will remain a popular choice for managing basin water resources in the immediate future too. However, creation of surface storage generally results in environmental consequences which may endanger the functions of natural river ecosystems, and in turn ecosystem services to humans. A question that has not been well answered yet is, the optimal (sustainable) upper limit (tipping point) to surface water storage development within a basin, which maximizes benefits from storage, and ensures the sustainability of both the benefits as well as the aquatic ecosystems that originally depended on the impounded water. This paper presents a possible approach to identify such a limit by studying the conjunctive behaviour of a set of indicators defining both water resources sustainability and ecological sustainability under different storage capacities and reservoir network configurations. The suggested indicators include, among others, safe yield, hydrologic sustainability, environmental flows and river fragmentation. The aim of the exercise is to identify an optimal suite of options, which maximises reservoir yield, hydrologic sustainability, and environmental flows, while minimising river fragmentation impacts in individual river basins, by studying the conjunctive behaviour of these indicators under different storage capacities and reservoir network configurations.



303/C

### Pollutant load assessment of Kalu *ela* sub basin of Kelani river lower reach

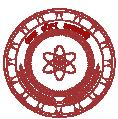
H M S S Sandarekha<sup>1</sup>, P A K Sameera<sup>1</sup>, G L Jayathunga<sup>1</sup>, G A A U Perera<sup>2</sup> and B C L Athapattu<sup>1\*</sup>

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Water is only second to air for the human being and a key factor in sustaining human life. The demand for good quality potable water increases with increasing population, urbanization, and industrialization. The water quality of rivers is of vital importance since rivers are the major source of the potable water supply in the country. The Kalu *ela* basin is the secondly highest polluted sub catchment among the Kelani river sub catchments which covers an extent of nearly 59 km<sup>2</sup>. The present study focused in estimating the pollutant load of Kalu *ela* basin as it represents pollution status and it is alleged that the assessment of pollutant load could address present, water scarcity in future. The Hydrological Modeling System (HEC-HMS) was designed to simulate the precipitation-runoff process of five dendritic drainage basins. Area of sub basins, SCS curve number, lag time and precipitation data were considered as the main input parameters for the model. Eleven water quality parameters namely pH, salinity, turbidity, conductivity, total dissolved solids (TDS), nitrite-nitrogen (NO<sub>2</sub><sup>-</sup> - N), phosphate-phosphorous (PO<sub>4</sub><sup>3-</sup> - P), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD) and chloride (Cl<sup>-</sup>) were tested. The total discharge at the outfall of the Kalu *ela* basin was given by HEC-HMS simulation processed as 2.967m<sup>3</sup>/s. The concentration of Cl<sup>-</sup> was 83.12mg/L while COD was 46.8mg/L. Salinity, turbidity, TDS and conductivity were 400mg/L, 24 NTU, 1769 mg/L and 295 µs, respectively. Pollutant loads of Cl<sup>-</sup>, COD, BOD, DO, PO<sub>4</sub><sup>3-</sup>, NO<sub>2</sub><sup>-</sup> were estimated at 246.6, 138.9, 13.18, 5.1, 4.7, 0.05 g/s respectively. The Cl<sup>-</sup> concentration in the Kalu *ela* was considerably higher than the other observed parameters and it is suspected that the Cl<sup>-</sup> and salinity was influenced due to tides flow and also due to leachates of sea sand, which was used for sub-grade of Katunayaka - Colombo expressway. The results revealed that monitoring mechanisms are required for industries to control the receiving pollutant loads to the Kelani River and accelerate the proper wastewater management systems. Therefore, water quality monitoring is essential to identify and mitigate anthropogenic activities to prevent further pollution of the Kelani river sub catchments.

**Keywords:** Kalu *ela* basin, Water quality, pollutant load assessment, Kelani river lower reach, HEC-HMS simulation



304/C

**Diyawannawa canal network for passenger boat service: a case study on water quality of Kirulapone canal**

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Currently the Kirulapone canal is under observation due to re-launch of the boat service as a solution for the peak traffic congestion in the Colombo Metropolitan area. It is one of the most polluted canal branches of Diyawannawa canal network due to the anthropogenic waste water disposal and storm water. The highly deteriorated water quality has become a dominant challenge to fulfill the above. The persecuted fragrance, eutrophication and unpleasant view are recognized as the pivotal barriers for the success of the transportation vision through this canal. The gradual renovation and maintenance of the canal network for boat passenger service would be beneficial to provide a reliable, time saving and a safe mode of public transportation system. The main objective of this study is to identify the most problematic water quality parameters and pollution sources of Kirulapone canal. The present protocol describes the pilot scale study on the canal water quality in the tributaries and Kirulapone canal to ameliorate the main canal to use as an alternative transportation route in the city of Colombo. Composite samples were collected monthly from the middle of the canal for testing water quality parameters such as nitrate and phosphate while data were obtained for pH, DO, temperature, salinity, EC and TDS from April to July 2016 for assessing present pollution status of the Kirulapone canal. During water sampling, stratification behaviour was studied by obtaining data such as DO, salinity, temperature and pH at different depths along the Wellawatta estuary. According to the test results DO, TDS, BOD and phosphate along the canal differed from stipulated values while pH, nitrate and salinity of the canal water were within the range introduced by the proposed water quality standards for inland waters by CEA. There was no salinity difference between top and bottom layers of canal water. Therefore, this study revealed that the Kirulapone canal water has low dissolved oxygen concentrations of limited nutrients such as N and P in selected tributaries. Hence water quality of Kirulapone canal need to be controlled through appropriate mitigatory measures before providing canal transportation. No stratification was observed at the downstream of the Kirulapone canal in the Wellawatta area.



305/C

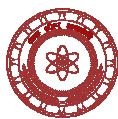
**A comparative eco-hydrologic study of perennial and non-perennial streams of a headwater catchment**

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Non perennial streams (NPS) account for almost half of the stream length in many headwater catchments. NPS are important due to their high storage capacity of storm water before flooding. Also, they provide habitats for several species. The main objective of this study was to investigate eco-systems associated with NPS, one of least studied freshwater ecosystems.

This was carried out by way of a comparative study between NPS and perennial streams (PS), in stream reaches connecting to Walawe River. Water quality in both stream types seemed to be more or less the same. However, some morphological features and vegetation showed significant differences. NPS showed less plant diversity, abundance and primary production relative to PS. This was further validated by seedling tests. Low intervention by plants is important when it comes to flood control. Further studies are recommended on this platform for NPS's eco-hydrologic roles as a flood controlling ecosystem.



306/ C

**Reuse of reverse osmosis concentrate for burnt clay bricks production**

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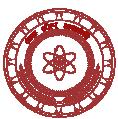
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It has been widely accepted that supply of good quality drinking water is one of the most important interventions to prevent the widely spread Chronic Kidney Disease of unknown etiology (CKDu) in the North Central Province. Therefore strategies such as installing Reverse Osmosis (RO) plants to supply potable drinking water for CKDu affected areas were implemented. However, treated effluent of a plant varies from 30-50%, so that a large amount of water concentrate is released to the environment which may create environmental pollution in long term practice. A project was carried out at Sangilikanadarawa RO plant in Medawachchiya DS division during the period of March to June to investigate the possibility of manufacturing clay bricks using RO concentrate as the water source. The bricks were casted using two different water samples namely well water and RO concentrate following four steps: winning of clay with different water samples, molding, drying and firing. After drying of raw bricks firing was done for five days using local fire wood. Twenty four numbers of bricks in each sample were subjected to tests for sound, hardness and visual inspection while laboratory tests such as dimension, compressive strength, water adsorption were conducted for both samples. The test results showed that the compressive strength of bricks made using RO concentrate was significantly higher than the groundwater, with no significant changes identified for other characteristics in both the samples. Based on the results, it can be concluded that Reverse Osmosis concentrate can be used for the brick manufacturing process.

**Keywords:** CKDu, RO concentrate, brick manufacturing, burnt bricks quality, compressive strength



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### Optimization of Industrial Building with Shell Type Building

D I Fernando, H M G C Herath and R J M Perera

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There has been a massive renaissance occurring within the construction industry due to the rapid economic development in conjunction with the vast urbanization processes which are taking place in the country. Ordinary types of buildings occupy more space due to the requirement of more columns and large beams which causes wastage of space. This is largely a hindrance to the industrial sector where capital costs play a vital role together with space therefore a solution to all these problems is in the construction of shell type buildings. Shell type buildings occupy less space and therefore provide some surplus space from the already available space which can be used for other useful or fruitful purposes to further the growth of and organization. The base model that was selected was a factory building belonging to POLIPTO which is based at the BOI investment zone in Horana. This is an ordinary rectangular type building which consists of a floor area of 975m<sup>2</sup>. A dome structure was designed for an equivalent to that area. A manual design was performed for the selected dimensions. Dome dimensions were selected relevant to the rectangular building. Span of the dome was 48m while height of the span was 8m. The selected dome area was larger than the rectangular building area. The total area of the dome cannot be considered as the total workable area due to the shape of the dome. This is due to the shape being spherical. A sky light was designed in order to allow ventilation inside the dome. Sky light was designed at 7.51 m above the floor level. Reinforced concrete spherical shell structure was designed by using the SAP 2000. For analyzing the dome, 40 angular divisions were selected. According to the project, the cost of the dome was higher than the rectangular building but when the area was widened without any columns and beams the dome structures were suitable. Concrete was selected due to the many beneficial properties it offers such as easy processing, high compressive strength and high durability. The structural stability of the domes are more in comparison to the ordinary rectangular type buildings in their ability to withstand natural environmental disasters such as tornadoes, hurricanes, cyclones etc.



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**Research on metal fatigue of the University Of Peradeniya: The state of the art**

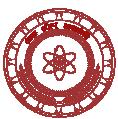
C S Bandara\* and P B R Dissanayake

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Since the initiation of research on fatigue of metals in the 1840s, many studies were carried out globally to understand the fatigue failure mechanisms, assess the fatigue damage and determine the fatigue life of structures and components. The Department of Civil Engineering, Faculty of Engineering of the University of Peradeniya (UOP), Sri Lanka started research on fatigue assessment of existing iron and steel bridges in the 1990s.

The present study is a review of the major research of the UOP on metal fatigue. The review shows that the studies of the UOP cover high cycle and gigacycle fatigue failures that occurred due to service loading conditions, ultra low and low cycle fatigue failures due to extreme loading events, fatigue damage accumulation methods and fatigue damage prediction models. The findings of the continuous research of the UOP on metal fatigue were gathered to introduce the "State of the Art Fatigue Damage Assessment Method" of the UOP.

**Keywords:** Metal fatigue, iron and steel bridges, cyclic loading, damage assessment



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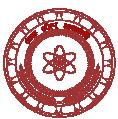
**Real strength of in-plane restrained slabs using compressive membrane action theory**

G Thamarajah

*Sri Lankan Institute of Information Technology, Malabe*

In-plane restrained slabs and beams are different to simply supported or rotationally fixed ones. Free to rotate condition for simple supported members and rotationally fixed condition for restrained members are assumed in determining flexural strength of structural members. However, restraint to in-plane expansion due to deflection has largely been ignored in determining service and ultimate load behaviour of flexural members. Restraint to in-plane expansion induces compressive membrane action (CMA) or arching action in slabs and beams. Experimental investigations carried out on in-plane restrained slabs and beams show the enhanced strength capacity of flexural members due to compressive membrane action or arching action. However, only a few design codes and guidelines incorporate the benefits of CMA. Hence slabs and beams are designed for much higher strength capacity than required. Understanding the influence of CMA is beneficial as it can contribute to reduction of reinforcement in in-plane restrained flexural members.

This study discusses the CMA theory that was proposed by Rankin. Test results from two different experimental investigations were obtained and strength of the slabs were predicted using standard flexural equations proposed in BS EN 1992-1-1 and CMA theory. The comparison of the test results with predictions demonstrates the influence of compressive membrane action and emphasizes importance of arching resistance in design calculations.



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**Developing a double drill machine to enhance the accuracy of the drilling process in brush manufacturing**

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The brush manufacturing industry is one of the growing industries in Sri Lanka. The brush blocks making process consists of timber seasoning, route ring sanding, painting and drilling processes. The drilling specifications should be maintained according to the customer requirements. They are; diameter of the holes to be drilled in the brush block, inclination of the holes' axes, angle of the nail-hole, depth, position, nail hole- diameter & position, and brace hole- distance & diameter. These factors are crucial factors in order to make quality brushes in the manufacturing process. It was identified that the absence of a proper clamping mechanism in the bench drill machine has led to incorrect positioning of the drilled holes. The objective of this study was to re-design and convert an existing bench drill machine to a double drill machine by introducing a new mechanism to have proper clamping system and rotatable twin drill headers to overcome the above mentioned problem. The main components of the double drill machine were identified and considering the specifications that have to be maintained in the drilling process, detailed design for modification of the existing bench drill machine was carried out. The double drill machine was fabricated according to the design parameters and few trials were conducted to compare the performances of the two machines. Results showed that the vertical deviation of the position of holes drilled by the double drill machine was between  $\pm 0.5$  mm where as that of the bench drill machine was  $\pm 1.5$  mm from approved sample measurements. Also the lateral deviation of the position of the holes drilled by the double drill machine was found to be in the range of 0-0.6 mm where as that of the bench drill machine was as far as 3 mm from approved sample measurements. Normally  $\pm 0.5$  mm tolerances in positioning are acceptable for brush blocks. When the cycle time (CT) for the complete drilling operation was compared, with double drill machine average CT was 29 seconds whereas for bench drill machine it was 33 seconds. It can be concluded that the developed machine is capable of performing the drilling operation faster and with improved accuracy.



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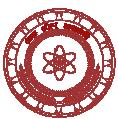
### A study of a fingertip imitating robot manipulator

P D S H Gunawardane, N T Medagedara, B G D A Madhusanka

*Department of Mechanical Engineering, The Open University of Sri Lanka, Nawala*

Hand gesture controlled robot manipulator for medical applications is a novel methodology of developing a medical robot. This project evaluated the effectiveness of master designs in bilateral systems for an epidemic environment and then identified the hand gesture vision attentive to be more effective. Therefore a system was designed to track and extract the position, orientation and the velocity of a fingertip using LMC (Leap Motion Controller) and then imitate in a 3DOF (Degree of Freedom) robot. The mathematical model was developed for tracked fingertip position, robots kinematics (forward kinematics, inverse kinematics and joint space velocities), robot dynamics (joint torques by considering zero friction) and trajectory generation (considering 5<sup>th</sup> order trajectory polynomial). The mathematical model was verified and analyzed using Mathematica 10 for all three joints for a particular case by plotting graphs of angle vs time, velocity vs time and acceleration vs time

**Keywords:** Medical robots, hand gesture controlling, leap motion controller, augmented reality, interactive programming



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### Use of bio-diesel as a soot inhibitor in diesel engines

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Diesel combustion emission results in a complex mixture consisting of a wide range of organic and inorganic compounds distributed in the gaseous and particulate phases. The particulate phase is commonly referred as soot. Soot particulate size in diesel emissions is very small (90% of them are less than  $1\mu\text{m}$ ), making them conveniently breathable with air. These particles adsorb in chemicals onto their surfaces. The mechanisms that produce soot in flames are among the most important unresolved problems of combustion science. The soot formation process starts with fuel containing 12 to 24 carbon atoms per molecule with hydrogen to carbon (H/C) ratio of about 2. This process ends up with molecules having about  $10^5$  carbon atoms and H/C ratio of 0.1.

Research carried out in combustion science has shown that aromatic and polycyclic aromatic hydro carbon content has great influence on soot formation in diesel engines. Soot is formed at high temperatures such as 1000 to 2800 K, and pressures between 50 to 100 atm, even with sufficient oxygen for complete combustion of the fuel in the combustion chamber.

The current research was based on production of bio-diesel and experimental investigation into soot suppressing effect of bio-diesel. A range of blends of diesel fuel and bio-diesel was tested in an engine. Since bio-diesel is based on naturally occurring triglycerides, the absence of aromatic and polycyclic aromatic hydrocarbons is a great advantage in terms of self ignition properties. Further, bio-diesel contains certain amount of oxygen in the fuel itself. Though aromatic and polycyclic aromatic hydrocarbons are acted as precursors for soot in flames, bio-diesel does not provide necessary precursors for soot formation. It was revealed in the experimental investigation that bio-diesel in a blend of diesel fuel had a significant soot inhibiting effect.

**Keywords:** Soot, soot formation and inhibition, oxygenated fuels, bio-diesel



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**A study on pictorial expression of the Kandyan school art style: Gangaramaya temple murals,  
Kandy**

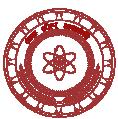
D S Wijerathne

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Kandyan school art style was widely spread in temple murals of Sri Lanka during the late 18<sup>th</sup> century AD, especially during the Kandyan kingdom. Many temple murals were restored and repainted as a patronage to Buddhist revival in the country during the South Indian ruling period of the Kandyan kingdom. Development pattern of the historical art style of Sri Lanka shows traditional art practices that can be clearly traced up to the Kandyan school art style. The Kandyan school art style shows some similarities with both ancient world art practices as well as contemporary drawing style practices in the world. This research focused on studying communication techniques that were practiced in mural paintings of the Kandyan school art style especially in relation to Central Kandyan art, to develop a method to visually communicate ideas that stands with the Sri Lankan identity.

The study was conducted based on primary and secondary data. Primary data for the case study were gathered from the mural paintings of the Gangaramaya temple, Lewella, Kandy. These murals were examples of well preserved Central Kandyan school art style. Further observations were carried out on paintings of Madawella and Degaldoruwa, Kandy, Ridiviharaya in Kurunagala and Dabulla raja mahaviharaya, Dabulla. Tests derived theories were based on independent observations discussed by line drawings of some of the selected murals. Analysis of drawing practices on murals was derived based on the design elements and design principle applications. Successiveness of conveying messages, idea or expression were analysed related to the context of the drawing.

Kandyan school art style used more expressive communication methods in paintings to convey ideas in a pictorial manner. A limited colour scheme was practiced to symbolically communicate different ideas. Clear, simple lines were used to highlight all figures and decorations. Rigid, curvy and wavy lines, repetitive and gradations techniques were normally applied. More than two dimensional settings in some places set depth in drawing using shading and highlighting techniques in colour application. Miniatures, two dimensional figure forms with less proportion were commonly used. Clothing's were used as symbols to convey status of figures contemporary to the story. Kandyan school art style used successful communication methods to visually convey ideas through drawings more related to the form of graphical communication. Line practices in drawings, shapes, composition and rhythmic applications added were more advantages to derive unique drawing features of Sri Lankan art practices.



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**Online monitoring and mapping of water quality of wells in rural areas of Sri Lanka**

S A D A N Dissanayake<sup>1\*</sup>, D S K U Wijesinghe<sup>1</sup>, H Pasqual<sup>1</sup> and B C L Athapattu<sup>2</sup>

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Water quality testing and monitoring is essential in North Central Province of Sri Lanka due to the prevailing health problem of Chronic Kidney Disease of unknown aetiology (CKDu). In addition mapping of fluctuation of water quality of wells is required to identify the prevalence and aetiology for monitoring environmental factors of this multi-factorial disease. Examining a well water sample is costly and time consuming due to transportation to the laboratories and manual procedures, which could be replaced using portable instruments or fixed sensors with online monitoring. However, portable instruments need technical assistance while fixed sensors require fixed separate sensors for each water quality parameter at all locations which again is costly. Recent developments in internet of things (IoT) could be used to monitor water quality. However it requires accessibility to wireless network. Therefore, a portable automated instrument along with online monitoring and mapping can help minimize the stated issues. This research study focused on online monitoring and mapping of groundwater wells using in-situ colorimeter. In this study, well water quality was monitored in rural area of Medawachchiya and mapped to obtain special distribution of selected water quality parameters. A portable automated measuring instrument was developed to detect pH, conductivity, hardness and fluoride concentrations of water, interfaced to an online monitoring system, which helps to display spatial distribution of said parameters. A GSM module, arduino controller and raspberry pi processor were used to implement the system. Detected levels of test parameters and the location coordinates were sent via a SMS (Short Message Service) to a central location. Remote access data acquisition system was improved by applying an error control coding method. In the central monitoring station, information received was processed using MySQL database and the risk levels of the tested water were indicated with colour variation with its location in the google map. The in-situ colorimeter provides water quality parameters with 90% accuracy, and latency of the communication system depends on the GSM network where data analysis and mapping takes less than 2 minutes. Highly accurate data was obtained without failures such as transmission errors. The spatial distribution map shows groundwater wells under risk in red while the others are in green. Invented in-situ system online monitoring and mapping helps to identify wells and households that need immediate attention, and effectively reduces the time taken for operation and decision making.



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### Design of a wireless sensor network for rice store monitoring

D N Balasuriya

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Extreme hunger prevailing in many of the third world countries is hindering the global development. Ever growing demand for food and the uneven distribution of the world's food consumption has been two main causes of this crisis. Simultaneously, waste of food due to aging, improper handling in transport and poor storage facilities are also fuelling the inadequate food supply for many. Rice, being a seasonal crop requires storage, usually carried out by filling into sacks and piling up in a store. However, most of these stores are of very poor quality and the grain sacks are susceptible to pest attacks and wetting. Wetting is a very serious issue which initiates sprouting, thus making rice unsuitable for human consumption. This study proposes a wireless sensor network (WSN) for monitoring such wetting conditions which is very beneficial in avoiding further damage. The key element of this WSN is the battery powered sensor node which is placed inside each and every sack during filling to detect two important parameters, namely temperature and the presence of moisture inside the sack. An LM35 temperature sensor and a DTH11 moisture sensor are employed in monitoring while an Arduino-Uno microcontroller collects the sensed information and then passes to the radio frequency (RF) communication module. Furthermore, one of the main contributions in this work is the introduction of a relay based communication from a sensing node to the external alarm notification unit. The relay based communication network facilitates a RF signal based communication over tens of meters of rice which is impossible to be achieved via a single point to point communication. Simultaneously, the sleep-wake up based power saving mechanism employed increases the battery life considerably, thus dramatically improving the node's lifetime close to one year. Its robust construction, power saving mechanism and also the capability to relay the sensed information to a monitoring station through many meters of rice makes this superior over many existing similar sensor networks. A prototype system with two sensor nodes and an alarm notification unit verified almost a 100% accuracy in communicating within 1m of rice. Moreover, the power efficiency of the proposed system is such that the node can survive 322 days without recharging, which is well within the requirements of a WSN. However, the system is limited by the cost of the communication devices. Nevertheless, improving the lifetime of the batteries further and the investigations on such power saving mechanisms would be an interesting future research area.



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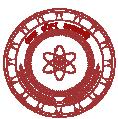
### Voice controlled home automation system for disabled people

D S K U Wijesinghe<sup>1\*</sup> and H Pasqual<sup>2</sup>

*Department of Electrical and Computer Engineering, The Open University of Sri Lanka, Nawala*

The evolution and development in the home automation systems are moving towards the future in creating the Smart Home Automation environment. Several commercial products are already available in the market and most of them are activated with remote controllers. However, such devices require buttons or touch screen system. Therefore, monitoring and controlling of the appliances need some movement and physical contact. We see this need as a burden to disabled elderly people in society. In today's context speech recognition is considered as a revolutionary concept capable of fully automating consumer centric electronic systems. In this situation, voice based control of electronic devices is being actively explored by many researchers; the users however have been reluctant to employ these devices due to higher initial cost.

In this project, the main objective was to develop a simple and cost-effective voice controlled home automation system for disabled people and to create a user dependent speech recognition system. This system is embedded with the capability of understanding human speech in Sinhala language. In order to achieve this goal, human speech signals are recognized and converted into effective commands to control the on/off status of electrical devices, such as lamps, fans, television etc., in the home. First, the voice command will be captured and its features extracted by using MFCC (Mel-Frequency Cepstral Coefficients) and then fed to a neural network to recognize the command. There are two phases in supervised pattern recognition, training and testing. As a result, home appliances could be turned on or off depending on the voice command given. During the training phase, parameters of the classification model are estimated using a large number of class examples (training data). During the recognition phase, the features of test pattern (test speech data) is matched with the trained model of each and every class. In this project, sixty speech samples were stored in the training model database and each sentence was recorded ten times. After successful identification of the command it will be fed to the microcontroller, which will then activate the corresponding actuator. During the initial voice recording process, it was observed that accuracy of the recognition varied with the length of the voice clip hence the voice clips must be recorded within 3 to 5 seconds. The overall accuracy of the system is approximately 75% and it will be dependent on sample size of Artificial Neural Network (ANN), words used and also the environment when uttering the particular words.



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### A domain specific visual programming language for designing embedded systems

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A Domain-Specific Language (DSL) is a computer language specialized to a particular application domain. The Visual Programming Language (VPL) allows users to create programs by manipulating program elements or visual building blocks graphically rather than by specifying them textually. Today, we are using modern smart electronic appliances which are running on embedded systems to facilitate our needs. Also there are many industrial automation applications as well. In order to program these, the programmers need specific programming skills related to the different programming language for different hardware platforms. The aim of this research project was to design and develop a visual programming language for developing the embedded systems applications without depending on programming languages. Developed visual programming language facilitates graphical building blocks to interface different input and output devices with the existing embedded system. The proposed system use compiler theory and tools such as Lex, YACC etc. The top layer of the proposed architecture graphical UI consists of physical design, logical design and code view in order to reduce the programming complexity of the users. The intermediate layer consists of Intermediate code as a regular expression. The final layer of the proposed architecture consists of Lexical analyzer, Syntax analyzer and Code generator. The language of the proposed domain specific compiler use context free grammar derived based on a microcontroller preferably 8051 in the implementation. The results show that the behavior of above three layers produce zero error assembly codes which can be burned into the microcontroller. For example, when programming a digital UP/DOWN counter, the user needs to connect two push button switches as input devices and seven segment display as an output device in the GUI using the visual blinding blocks while providing the expected behavior in the logic flow according to the user's choice. Then the system generates relevant assembly language codes which are executed in the 8051 based embedded system. The main advantage of the proposed system is providing a user friendly, simple graphical user interface to program the complex embedded system applications rather than following complex programming languages given by different vendors for the different microcontrollers. At the implementation stage, 8051 microcontroller based embedded system platform is used. However, this system can be extended to program or reprogram the other microcontrollers as well without changing the front end GUI and the proposed architecture.

Keywords: VPL, DSL, DSC, LEX, YACC, embedded systems



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**Modeling of gravity anomalies over a sedimentary basin having intruded horizontal  
Igneous layer**

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In certain places sedimentary basins have layers of high dense igneous intrusions emplaced as almost horizontal thick sheets. Very often such igneous layers are misinterpreted as basement rock when drilling test wells for oil exploration resulting in abandonment of the drilling process unaware of the fact that the sedimentary basin continues below the igneous rocks. Igneous layers of this nature have been reported in the Mannar Basin in the North Western off shore regions of Sri Lanka. It is worthwhile to have a method of ascertaining whether the igneous rocks encountered in the drilling process belong to the actual basement or to a sheet of igneous rocks intruded into the sedimentary basin. An attempt was made to examine whether the modeling of gravity anomalies caused by a sedimentary basin having an igneous layer intruded into it using the Backus and Gilbert method can be used for this purpose.

A mathematically rigorous approach of solving the inverse problem in geophysics for the under-determined case is described by Backus and Gilbert. This inversion method is based on a mathematical abstraction called an "Earth Model". An idealized model known as an "n-dimensional Earth model" can be considered as a point in an infinite dimensional linear space of all conceivable Earth models. In this method, a model that satisfies a set of observations is created by minimizing the distance between an initial model and the real Earth model in the parameter space, subject to the constraints imposed by observations.

In this study, it was been assumed that the igneous layer is of infinite extension and the density contrast of sedimentary rocks is  $-0.3 \text{ g/cm}^3$  and that of the igneous intrusion is  $0.3 \text{ g/cm}^3$ . Gravity anomaly due to this model structure was calculated and the results were used as observations to solve the inverse problem. Gravity anomaly was first modeled in terms of a body with single density contrast  $-0.3 \text{ g/cm}^3$ . Then an igneous layer of thickness 0.2 km and density contrast of  $0.3 \text{ g/cm}^3$  is introduced at a depth of 1.0 km to this model and divided into 22 strips of thickness 0.1 km.

The numerical experiment was repeated for two different values of thicknesses of the igneous layer (0.5 km, and 1.0 km) and results obtained for these two cases were not as consistent as the density distribution obtained for the case where the thickness of the igneous layer is 0.2 km. The results conclusively showed that modeling of gravity anomalies using the Backus and Gilbert method can be used to determine whether the igneous rocks encountered in the drilling process belong to the actual basement or to a sheet of igneous rocks intruded into the sedimentary basin.

**Keywords:** Modeling gravity anomalies, sedimentary basin, intruded igneous layer  
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### Statistical quality control approach based on double sampling method

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<sup>1</sup>*Department of Mathematics, Faculty of Applied Sciences, University of Sri Jayewardenepura*

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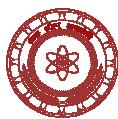
<sup>3</sup>*SL Organisation, 156/5/G, Weragala Place, Talawatugoda*

This study investigated whether quality inspection practices of the SL Organisation can be enhanced by applying statistical quality control techniques, which mainly is a combination of acceptance sampling and statistical process control. The two main objectives of this study were to investigate the possibility of implementing statistical process control techniques into the current inspection process, and to examine the possibility of enhancing the currently used acceptance sampling methods.

A stepwise approach is designed in applying statistical process control to a production process where the steps include identifying the potential types of defects, identifying the production stages and the critical stages for quality, measuring the potential defects using check sheets, creation of Pareto charts to find out which defects are most common, carrying a cause and effect analysis to improve the production process and creating control charts in order to monitor the production process. Ceylon Paper Pottery factory on which SL Organization carries out quality inspection, was selected to test the success of the implementation of statistical process control techniques.

In order to improve the acceptance sampling methods, the protection level of currently used sampling tables in the industry were assessed via operating characteristic curves and average outgoing quality curves. Hence the most suitable sampling plans were identified using the general level 3, tight inspection sampling table in ANSI/ASQ Z 1.4. Also, in order to reduce the inspection cost, reduction of the number of inspections required is considered. To achieve this objective, sampling plans which have lower average total inspections and double sampling plans with average sample number lower than the sample size of single sampling plans were identified while providing the same protection level. Specifically, this study recommends SL organization to use ANSI/ASQ Z 1.4 double sampling plans at general level 3 tight sampling plan when the lot size is below 1200, and general level 2 tight sampling plan otherwise.

**Keywords:** Statistical quality control techniques, acceptance sampling, statistical process control



## Section D

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### Records of Mid Holocene Sea Level Highstands from Southern and Northern Sri Lanka

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<sup>2</sup>Geological Survey & Mines Bureau, Pitakotte Sri Lanka

<sup>3</sup>Department of Hydrography, Sri Lanka Navy

Understanding long term natural sea level variability is a fundamental requirement to predict the future variability. Lack of long-term sea level record for the Central Indian Ocean and discrepancies in existing Holocene records prompted us to carry out this study to understand the Holocene sea level changes in the Indian Ocean around Sri Lanka. Emerged coral reefs, which are good indicator for understanding long term sea level variation, were sampled for age dating at Madhihe, Akurala, Southern province and Delft Island, and Kurichchikadu in Northern province by hand drilling. Ages were determined by AMS and Gas Bench radiocarbon dating. Elevation of the sampling location were measured by leveling to the mean sea level.

Radiocarbon dating yielded  $3853 \pm 32$ ,  $5050 \pm 30$ ,  $5573 \pm 27$ ,  $6194 \pm 28$ ,  $6360 \pm 160$ ,  $5839 \pm 28$ , cal yrs BP ages for corals situated -0.066 m, -1.4212 m, +1.346 m, +1.5838 m, and +0.2099 m msl respectively. Results provide strong evidence for submergence of North, South and south western Sri Lanka by a minimum +1.5 m sea level highstand around 5050 – 6300 cal yrs BP during Holocene highstand. Minus elevation in Akurala and Madihe areas suggests that coastal lowlands of south western were converted to paleo bays during the Holocene highstand.

**Key Words-** Coral, Southern province, Northern Province, Holocene, Indian Ocean, Sea level

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401/D

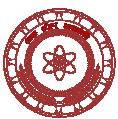
**The mature leaf concentrate of Sri Lankan wild type *Carica papaya* L attenuates carrageenan induced acute inflammation via inhibiting prostaglandin E2**

C D Jayasinghe, W D Ratnasooriya and Preethi V Udagama \*

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Chronic inflammation plays a critical role in the development of major non communicable diseases such as cancer, diabetes, cardiovascular diseases and neurodegenerative diseases. These diseases are either treated with steroidal or non-steroidal anti-inflammatory drugs, the long term usage of which is limited due to adverse side effects. Alternatively, medicinal plants offer a safe, effective and readily available source of anti-inflammatory remedies. Previously, the anti-inflammatory potential of mature leaf concentrate of *Carica papaya* (red lady cultivar) was validated using carrageenan induced paw edema, membrane stability and acetic acid induced vascular permeability in murine models. The present study aimed at investigating the effect of the mature leaf concentrate of *Carica papaya* of the Sir Lankan wild type cultivar (MLCC) on carrageenan induced peritonitis and synthesis of prostaglandin E2 in mice. ICR mice (N=6/group) were orally treated with the MLCC at three doses; 0.18, 0.36 and 0.72 mL <sup>-100g</sup> body weight (BW), distilled water as the control and Indomethacin (40 mg kg<sup>-1</sup>) as the positive drug. One hour post drug administration, 1 ml of 0.3% w/v carrageenan in sterile saline was intraperitoneally injected. Four hours later peritoneal exudate was collected and evaluated for total and differential leukocyte counts and prostaglandin E2 (using Sandwich ELISA). A significant influx of total leukocytes including large proportion of neutrophils was observed in mice after 4 hrs post injection of carrageenan ( $p<0.05$ ). Oral gavage of 0.36 and 0.72 mL <sup>-100g</sup> BW and positive drug Indomethacin profoundly reduced the total leukocyte and neutrophil influx to the peritoneal cavity ( $p<0.05$ ). In parallel, prostaglandin E2 levels of cell free peritoneal aspiration was significantly increased by carrageenan injection compared with the normal mice ( $p<0.05$ ) and this level was significantly reduced by the oral administration of 0.36 and 0.72 mL <sup>-100g</sup> BW of the MLCC ( $p<0.05$ ). A significant correlation was observed between the inhibition of leukocyte migration and inhibition of synthesis of PGE2. *In toto*, the present study established that the MLCC attenuates carrageenan induced acute peritonitis of mice via inhibiting prostaglandin E2. Further, studies are warranted to investigate the selective inhibition of COX 1 or 2 pathways by the MLCC.

Acknowledgment: Financial assistance by the Collaborative Research Grant (AP/3/2012/CG/29) of the University of Colombo.



402/D

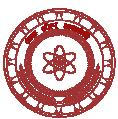
**Glycemic regulatory properties of fenugreek (*Trigonellafoenum-graecum*) seed extracts used in Sri Lankan ethnomedicine**

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Diabetes is a chronic metabolic disease rapidly increasing worldwide including Sri Lanka. Fenugreek seed extracts had long been used as a folk remedy for management of diabetes. In Sri Lankan ethnomedicine and folklore, water extracts of germinated fenugreek seeds (WEGFS) and seed flour (WESF) and hot water seed extracts (HWSE) were used to treat diabetes. However, such claims have not been scientifically validated to date. The present study evaluated a range of glycemic regulatory properties of fenugreek seed extracts used in Sri Lankan ethnomedicine. Freeze dried WEGFS, WESF and HWSE were used in this study. Glycemic regulatory properties; anti-amylase, anti-glycation, glycation reversing, anti-acetyl and anti-butyrylcholinesterase activities were studied via *in vitro* (n=3 each) assays. Results revealed significant differences ( $p<0.05$ ) among extracts for the glycemic regulatory properties tested. WEGFS exhibited significantly high ( $p<0.05$ ) glycation reversing ability ( $IC_{50}:131.19\pm2.47\mu\text{g/ml}$ ), anti-acetyl ( $IC_{50}:1194.38\pm48.61\mu\text{g/ml}$ ) and anti-butyrylcholinesterase ( $IC_{50}:245.15\pm1.30\mu\text{g/ml}$ ) activities compared to the other extracts. In contrast, WESF demonstrated significantly high ( $p<0.05$ ) anti-amylase activity ( $IC_{50} < 62.5\mu\text{g/ml}$ ) compared to the other extracts. Interestingly, anti-amylase activity of WESF was significantly higher ( $p<0.05$ ) compared to the reference drug acarbose ( $IC_{50}:100.11\pm6.79\mu\text{g/ml}$ ). Anti-glycation activity studied as a glycemic regulatory property was significantly high ( $p<0.05$ ) in HWSE ( $IC_{50}:81.62\pm1.59\mu\text{g/ml}$ ). It is concluded that WEGFS, WESF and HWSE exert its glycemic regulatory properties via multiple mechanisms and those extracts showed varying degrees of potentials in mediating such properties. This study scientifically validated traditional claims of Sri Lankan ethnomedicine on the use of fenugreek seed extracts in treating diabetes.



403/D

**Evaluation of larvicidal activity of aqueous leaf extract of *Citrus aurantifolia* (Lime) against house fly, *Musca domestica* L. (Diptera: Muscidae)**

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House fly, *Musca domestica* (Linnaeus) act as a major vector of many medicinal and veterinary pathogenic organisms. Increasing biomagnification of synthetic chemical pesticides on non target organisms leads to search on ecofriendly and biodegradable pesticides obtained from plants. Previous studies have revealed that products from citrus plant parts are effective against certain insect pests. This study aimed to evaluate the effect of aqueous leaf extract of *Citrus aurantifolia* on mortality of larvae of the house fly, *Musca domestica*, as an effective and eco-friendly larvicide. Five grams of pork meat was soaked for one minute in 0.002 g/ml, 0.001 g/ml, 0.02 g/ml, 0.03 g/ml and 0.04 g/ml of freshly prepared aqueous citrus leaf extracts or 50 ml distilled water (control). Subsequently, samples were transferred to separate watch glasses and placed within the six plastic bottles (500ml) separately. Fifteen numbers of third instar larvae from laboratory culture was introduced into each bottle and covered tightly with muslin cloth. Number of dead larvae was counted after 24hrs and 48 hrs of treatment. The LD<sub>50</sub> toxicity was determined based on mortality data at 24 hrs and 48 hrs assessments using statistical package Minitab. Five replicates were carried along with the control under laboratory conditions at temperature 26±2°C and 65-75% relative humidity. It was found that percentage mortality ranged between 17% - 52% and 32% - 69% after 24 hrs and 48 hrs of exposure respectively. LD<sub>50</sub> of the aqueous leaf extract of *C. aurantifolia* against third instar larvae of *M. domestica* was 0.0196 g/ml for 24 hrs and 0.034 g/ml for 48 hrs of treatment. From this study it could be concluded that the aqueous leaf extract from *C. aurantifolia* at 0.02g/ml have substantial capability to kill the larvae of house fly and hence aqueous leaf extract could be used as a potential natural larvicide.

**Keywords:** Aqueous leaf extract, House fly, *Musca domestica*, larvicide, *Citrus aurantifolia*



404/D

**Fluvial export variability of limiting nutrient fluxes to the Indian ocean from selected rivers in the wet zone of Sri Lanka**

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<sup>2</sup>*Department of Marine Sciences and Environmental Engineering, University of Connecticut, United States*

The wet zone of Sri Lanka is a region where a number of major rivers and streams originate in the country and deliver land borne limiting nutrients to the Indian Ocean to facilitate marine productivity and carbon sequestration. A study was carried out to quantify the contribution of Kelani River, Kalu River and Gin River in exporting major limiting nutrient fluxes to the Indian Ocean during South West monsoons and second intermonsoons, to understand the significance in their variability patterns with rainfall and to trace the nature of the input sources of these nutrients. A three month study from late August to early November, 2015 was conducted at pre-decided three sampling locations for each river and water samples were collected for analysis of ammonia, nitrite, nitrate, orthophosphate, silica, sulfate and iron. Analysis was done by standard colorimetric spectroscopy methods. In addition, rainfall, stream discharge, pH, DO, salinity and temperature were measured at the site itself. Only orthophosphate ( $p<0.01$ ), sulfate ( $p<0.01$ ) and nitrite ( $p<0.01$  for Kelani and Kalu;  $0.01<p<0.05$  for Gin) fluxes showed a significant relationship with the discharges showing that only less abundant nutrients are more affected to be dissolved in stream water with rising rainfall. None of the fluxes showed significant differences ( $p>0.1$ ) in their temporal and spatial variability suggesting that studied rivers in the wet zone more or less behave equally in fluvial transportation owing to the similar rainfall intensities observed in both SW monsoons and second intermonsoons. Calculated N:P ratios with respect to natural ratio of N and P (16:1) suggested a possible increase in N inputs in the fluxes probably due to dominating anthropogenic sources in Kelani (72:1), Kalu (73:1) and Gin (92:1) rivers and a possibility of P limiting conditions for the marine productivity of the adjacent coastal environment. Si:N in Kelani (4:1), Kalu (4:1) and Gin (4:1) rivers suggested an equally possible Si imbalance but is believed to be under control due to their high removal rates from a system and the detected molecular ratios being more closer to natural Redfield ratios (1:1).

Key words: Nutrients, fluvial, fluxes, ratios



405/D

**Extraction and quantification of vitamin A from livers and skins of selected reef fish species**

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Reef fish play an important role in the coastal fishing of Sri Lanka and provide special health benefits. Vitamin A is a valuable nutrient present in reef fish. This study was planned to extract and quantify vitamin A in the liver and skin of four reef fish species namely *Lutjanus rivulatus*, *Lethrinus olivaceus*, *Epinephelus undulatus* and *Lutjanus argentimaculatus*. Four replicate samples of male fish from each species were collected from Dondra and Matara of Southern Sri Lanka and their biological indices such as body weight, total length, liver weight and Hepato Somatic Index (HSI) were recorded. Vitamin A was analyzed using a colorimetric assay. The mean vitamin A content of the liver in *E. undulatus*, *L. rivulatus*, *L. olivaceus* and *L. argentimaculatus* were  $9246 \pm 2706$ ,  $8042 \pm 4705$ ,  $1998 \pm 1811$  and  $2128 \pm 856 \mu\text{g g}^{-1}$ , respectively. Statistical analysis showed a significant difference in vitamin A content in the liver among the four species ( $p < 0.05$ ). Correlation of vitamin A in the fish liver and biological indices of each species (body weight, total length, liver weight and HSI), indicated positive relationships ( $R = 0.574$ ;  $P < 0.05$ ). Respective mean vitamin A content in the skin of *E. undulatus*, *L. rivulatus*, *L. olivaceus* and *L. argentimaculatus* were  $2.7 \pm 1.0$ ,  $6.3 \pm 2.1$ ,  $4.8 \pm 1.5$  and  $6.2 \pm 0.8 \mu\text{g g}^{-1}$ . Fish skin comparatively had a much lower vitamin A content than of fish liver. One-way ANOVA indicated significant difference in mean vitamin A contents in skin of the four fish species ( $p < 0.05$ ). No significant correlations were detected between vitamin A content in fish skin and biological indices of each species (body weight and total length). In conclusion, *E. undulatus* and *L. rivulatus* contained significantly higher Vitamin A content in the liver.

**Keywords:** Vitamin A, reef fish skin and liver, *Lutjanus rivulatus*, *Lethrinus olivaceus*, *Epinephelus undulatus*, *Lutjanus argentimaculatus*



406/D

**Cloning and expression of 1,4- $\beta$ -D-glucosidase, endo- $\beta$ -D-glucanase and cellobiohydrolase genes of *Trichoderma* in yeast for the second generation bio-ethanol production from ligno-cellulosic biomass**

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Ligno-cellulosic biomass comprising of cellulose, hemicellulose and lignin is the most abundant renewable organic resource on earth and it has been the main target for enzyme based second generation bio-fuel production. Complete degradation of cellulose into glucose involves simultaneous action of the three cellulase enzymes, namely endoglucanase (*EGLI*), cellobiohydrolase (*CBHI*) and  $\beta$ -glucosidase (*BGLI*). Among all microbial genera, filamentous fungi *Trichoderma* species are known to be excellent protein secretors including cellulase. This study was focused on cloning three cellulase genes from *Trichoderma* into *Saccharomyces cerevisiae* to develop a recombinant yeast system, harbouring cellulase capable of producing ethanol from ligno-cellulosic biomass. Locally isolated *Trichoderma virens* species expressing cellulase was used to characterize and isolate the genes. The 1,4- $\beta$ -D-glucosidase I (*BGLI*) gene was successfully PCR amplified using genomic DNA. Endo-1,4- $\beta$ -D-glucanase I (*EGLI*) and cellobiohydrolase I (*CBHI*) genes of *Trichoderma* were custom synthesized and all three genes were separately cloned into pGAPZ $\alpha$  vector. They were individually transformed into *S. cerevisiae* and the recombinant clones were confirmed by colony PCR and sequencing. The expression of cloned genes was analyzed by cellulase activity assays and 12 % SDS-PAGE analysis. Recombinant clones showing the highest cellulase activity by filter paper assay (0.22 IU ml<sup>-1</sup>), cellobiase assay (0.425IU ml<sup>-1</sup>), carboxy methyl cellulose (CMC) assay (0.77IU ml<sup>-1</sup>) and exoglucanase assay (0.40 IU ml<sup>-1</sup>) were selected for further study. These recombinant yeasts were subjected to co-fermentation at 37°C under anaerobic conditions in a bench-top fermenter using pre-treated straw as the sole carbon source. Samples were collected at 24 hour intervals for ten days and were tested for combined cellulase enzyme activity of the three recombinant *S. cerevisiae* by determining the amount of glucose produced by glucose oxidase assay. Highest glucose production was determined as 0.7 mg/ml on the third day (72 hours) of the fermentation. The production of ethanol was determined as 7.2g/100g pretreated straw using the dichromate method. Above clones will have the potential to produce ethanol by simultaneous saccharification and direct fermentation of cellulosic biomass.

**Keywords:** Ligno-cellulosic biomass, cellulose, hemicellulose, co-fermentation, filamentous fungi, second generation bio-ethanol



407/D

**Molecular identification of root-knot nematode *Meloidogyne arenaria* on tomato (*Solanum lycopersicum*) in Sri Lanka**

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Root-knot nematodes (RKNs), of the genus *Meloidogyne* are ubiquitous plant pathogens with a wide host range. Tomato (*Solanum lycopersicum*) is regarded as its most favorable host causing an estimated yield loss of 24-38% worldwide. In this study, we developed a sensitive and fast PCR based diagnostic assay and accurately identified *Meloidogyne arenaria* parasitizing tomato in Sri Lanka. Tomato samples with extensive root galling and severe stunting were collected from the fields in Colombo and Kalpitiya in the years 2013/2014. Genomic DNA was isolated from RKNs extracted from infected roots using incubation method, sieving and centrifugal floatation. Primers optimized successfully resulted in amplification of DNA obtained from RKNs. Amplification of rDNA with MF/MR universal primers yielded 500 bp DNA fragments specific for the genus *Meloidogyne* for both samples. Amplification of mtDNA with C<sub>2</sub>F<sub>3</sub>/1108 primers yielded 1100 bp products specific for *M. arenaria*. Both samples were further analyzed with *M. arenaria* specific Far/Rar primers and 420 bp size PCR products were amplified. The sequences of the PCR products were 100% identical with sequence of *M. arenaria* isolates from Indonesia (GenBank Accession No. KP234264.1). Therefore, the population of RKNs isolated from tomato samples were confirmed as *M. arenaria*. In Sri Lanka, this nematode were reported to infect economically important crop plants such as eggplant, bitter gourd, chili, okra, spinach, snake gourd and pumpkin. However, thus far a comprehensive study on the RKN identification on tomato was not done in the country. To the best of our knowledge, this is the first report on infection of tomato by *M. arenaria* in Sri Lanka.

Acknowledgement: Financial assistance by the University of Colombo Research grant (AP/3/2012/CG/25)



408/D

**Development of recombinant *Pichia stipitis* harbouring endoxylanase and endo- $\beta$ -D-xylosidase genes of filamentous fungi for degradation of hemicelluloses**

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Production of second generation bio-ethanol has become a key area of research and development in many countries since alternate fuel production has become crucial for economic development. Hemicellulose is the second most abundant naturally available polysaccharide in the biosphere. Xylan is a major component of hemicelluloses in plant biomass and it is a polymer of 1,4-linked  $\beta$ -D-xylose units. Xylan can be hydrolyzed to fermentable xylose using xylanases. Two major xylanases, namely endo- $\beta$ -1,4-xylanase (EXN) and  $\beta$ -1,4-xylosidase (XYL) are needed for the complete hydrolysis of xylan. Endo- $\beta$ -1,4-xylanases cleaves xylan to produce xylo-oligosaccharides and  $\beta$ -1,4-xylosidases hydrolyzes xylo-oligosaccharides to D-xylose. Among all microbial genera these enzymes are produced in considerable amounts by two filamentous fungi species namely *Trichoderma* and *Aspergillus*. Among yeast species, *Pichia stipitis*, *Pichia segobiensis*, *Candida tenius*, *Candida shehatae* have the ability to utilize xylose for their growth and are also able to ferment pentose sugars to ethanol.

The aim of this study was to isolate endo- $\beta$ -1,4-xylanase (EXN) and  $\beta$ -1,4-xylosidase (XYL) genes respectively from *Trichoderma* and *Aspergillus* species, clone and express the enzymes in *Pichia stipitis* for the simultaneous saccharification and direct fermentation of hemicellulose into ethanol. Locally isolated *Trichoderma virens* and *Aspergillus niger* were selected and tested for hemicellulase activity. EXN and XYL genes were successfully PCR amplified from genomic DNA of *T. virens* and *A. niger*, respectively. Amplified genes were individually cloned into pGAPZ $\alpha$  expression vector and then transformed into *P. stipitis*. Recombinants were confirmed by colony PCR and sequence analysis. Putative recombinants were designated as Y-pGAPZ $\alpha$ /EXN and Y-pGAPZ $\alpha$ /XYL. The expression of EXN and XYL by recombinant *P. stipitis* was confirmed using standard hemicellulase activity assay using xylan as the substrate and 12% SDS-PAGE analysis. The determined enzyme activities for Y-pGAPZ $\alpha$ /EXN and Y-pGAPZ $\alpha$ /XYL were 529.3 nkat ml<sup>-1</sup> and 959.3 nkat ml<sup>-1</sup> respectively. SDS-PAGE analysis revealed fragments of 24 kD for EXN and 84 kD for XYL confirming expression of the recombinant proteins. Further studies will be conducted to optimize the enzyme activities expressed by the two recombinant *P. stipitis* clones to degrade and ferment hemicelluloses into ethanol from pretreated straw by anaerobic fermentation.

**Keywords:** Second generation bio-ethanol, hemicellulose biomass, simultaneous saccharification

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409/D

**Screening for anti *Leishmania* antibodies for visceral leishmaniasis and the presence of Leishman Donovan (LD) bodies in buffy coat films in patients in therenal unit in Teaching Hospital, Anuradhapura**

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Cases of visceral leishmaniasis (VL) complicating kidney transplantation have increased globally in the last decades. Leishmaniasis is endemic to Sri Lanka. It is well reported that VL could be asymptomatic up to 20% of an endemic community. Of those, only 5% will progress to VL depending on the patient's immunity and nutrition. The aim of this study was to screen for anti *Leishmania* antibodies for VL and assess the presence of Leishman Donovan (LD) Bodies in the buffy coat films in the patients with Chronic Kidney Disease (CKD) or who have undergone kidney transplantation (KT) in the Teaching Hospital, Anuradhapura (THA).

Clinical features and blood samples of 170 individuals were collected. Clinical features were assessed for the presence of VL signs and symptoms. Buffy coat films stained with Giemsa stain were examined for LD bodies in blood macrophages and serum samples were screened for the presence of anti- *Leishmania* antibodies using rK 39 rapid diagnostic test strip (rK 39 RDT). None of the patients had past or current history of CL or VL. All 170 (100%) patients were negative for Leishmania amastigotes in buffy coat films and rK 39 RDT for anti – *Leishmania* antibodies.

This study suggests that thus far, VL is not a major problem among patients with renal diseases in a CL endemic area in Sri Lanka. However, the risk of VL transmission by blood transfusions/ organ transplantations and the possibility of CL visceralization with immune – suppression could not be ignored. Therefore, more serological tests are recommended to arrive at further conclusions.

**Keywords:** Visceral Leishmaniasis, Leishman Donovan bodies, buffy coat films, kidney transplantation, asymptomatics

**Acknowledgement:** Financial Assistance by the University of Sri Jayewardenepura (Grant No. Asp/01/Re/Med/2015/45).



410/D

**Ants and scuttle flies as potential biological control agents of spinose ear tick  
*Otobius megnini***

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Current control strategies of ticks are exclusively based on applying chemical acaricides. Regardless of their effectiveness, intensive use can have negative impact on non-target organisms. *Otobius megnini* is a soft tick (Acari: Argasidae) that parasitizes many domesticated animals and humans and is a serious problem for the horses in the Nuwara Eliya race course. We studied the potential use of ants and scuttle flies in controlling *O. megnini* under laboratory conditions. *O. megnini* infesting the ear canal of stabled horses in Nuwara Eliya racecourse was brought to the laboratory and separated according to their life stage (larvae/ nymphs) and allowed to moult. Adults that hatched out were maintained in plastic grid plates to lay eggs and then the eggs were incubated in Eppendorf® tubes. Eggs, unfed/engorged larvae, nymphs and adults were left on the laboratory bench for ants to predate and scuttle flies to lay eggs. Observations were recorded from September 2014 to January 2015. A total of 50,000 eggs (500 batches having 100 eggs in each), 576 larvae, 650 nymphs and 450 adults were exposed to ants. Five ant species: two species of *Monomorium* (small black ant), *Pheidole* (big headed ant), *Tapinoma melanocephalum* (ghost ant) and *Crematogaster* (acrobat ant) were identified as predators of *O. megnini*. One *Monomorium* sp. and *Pheidole* sp. predated on 97 and 64 unfed larvae, respectively. Engorged larvae (n=206) and adults (n=150) were completely destroyed by *Crematogaster* sp. Rest of the ant species fed on adult ticks. Among the ants, *T. melanocephalum* was the best predator as it fed on free living adults (n=194) and eggs (213 batches). Nymphs were not predated by any ant species. Yet, nymphs are not free living and hence it is unlikely that the ants get a chance to predate on them under natural conditions. The scuttle fly *Megaselia scalaris* (Diptera: Phoridae) laid eggs on nymphs (n=41) and adults (n=84) of *O. megnini* and later, maggots fed on nymphs and adults. Pupae of *M. scalaris* were found attached to the emerged adult ticks. Adult flies emerged 15 days after the appearance of maggots. During the process, 90.2% of the adults were found dead and those remained alive were lethargic. Although the ants and scuttle fly can be used as effective biological control agents, more attention must be paid on consequences and subsequent impacts in the natural context.

Acknowledgement: National Research Council of Sri Lanka (NRC-11-44)



411/D

**Life cycle of *Haemaphysalis bispinosa*, Neumann, 1897 (Acari: Ixodidae) under laboratory conditions**

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*Haemaphysalis bispinosa* is a medically and veterinary important three-host, hard tick that is widely distributed in Sri Lanka infesting a wider range of vertebrates but cattle is the major host. This tick acts as a competent vector of Kaysanur Forest Disease virus, Q fever and babesiosis. This study was conducted to determine the life cycle pattern of Sri Lankan *H. bispinosa* population. Naturally detached female ticks who fed on cattle were collected, brought to the laboratory and maintained under laboratory conditions ( $28\pm1^\circ\text{C}$ , 80% RH) in plastic grid plates. Immature stages were reared on albino rabbits. Female ticks had an average weight of  $41.5 (\pm12.9)$  mg and completed oviposition within an average of  $8.8 (\pm2.8)$  days with a pre-oviposition period of  $10.1 (\pm0.9)$  days. A single female laid a total of  $541.2 (\pm218.2)$  eggs and the Reproductive Efficiency Index (REI) was  $13.5 (\pm4.1)$ . Larger females laid a higher number of eggs (Pearson correlation;  $r = 0.8$ ,  $p<0.05$ ). Incubation period at three different temperatures  $22^\circ\text{C}$ ,  $28^\circ\text{C}$ , and  $30^\circ\text{C}$  were  $31.0 (\pm1.9)$ ,  $16.9 (\pm0.9)$  and  $14.4 (\pm0.6)$  days and the incubation success were 73.8%, 95.1% and 96.4%, respectively. A majority (93.5%) of the larvae successfully moulted to nymphs with an average pre-moult period of  $7.8 (\pm1.1)$  days after a parasitic period of  $3.5 (\pm0.9)$  days. Survival period of unfed larvae at  $28\pm1^\circ\text{C}$  ( $87.3\pm16.3$  days) was significantly shorter (Two sample t test;  $p<0.001$ ) than that of at  $22\pm1^\circ\text{C}$  ( $150.5\pm7.5$  days). Nymphs completed the blood meal after  $4.6 (\pm0.7)$  days and had a mean weight of  $3.4 (\pm1.6)$  mg and majority (64.6 %) moulted successfully with an average pre-moult period of  $10.4 (\pm1.3)$  days. Unfed nymphs survived  $36.4 (\pm4.4)$  days. Heavier nymphs moulted to females ( $4.1\pm1.6$  mg) while lighter nymphs moulted to males ( $2.8\pm1.4$  mg;  $p<0.001$ ). Body weight of adult females could increase a maximum of 63 times. Adult ticks did not feed on albino rabbits. Unfed adults survived  $146 (\pm15.4)$  days. Duration of the life cycle ranged from 52-251 days. When the life cycles of Japanese, Chinese and Indian populations of *H. bispinosa* were compared with that of the Sri Lankan population, it shares similarities with the life cycle pattern of Indian and Chinese populations.

**Keywords:** Life history, cattle tick, *Haemaphysalisbispinosa*

**Acknowledgement:** National Research Council of Sri Lanka (NRC-11-44)



## Section E1

501/E1

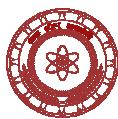
### A study on equiprobability of outcomes of two lotteries in Sri Lanka

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With many different lotteries being available and being popular the lottery regulators need to ensure the public that the games are played fair. In a lottery game where one character out of  $M$  different non-numeric characters and  $n$  numbers out of  $N$  different numbers are drawn, the fairness would mean the independence and equiprobability of outcomes. Usually, there is no reason to doubt the independence of outcomes on different days. However, the equiprobability of outcomes could be violated in many ways. This study presents data on a study on testing the equiprobability of outcomes of two lotteries, labelled as lottery1and lottery2, where drawing the numbers resembles sampling with-replacement and without-replacement respectively. The non-numeric character was ignored and only the n-tuple of numbersconsidered as an outcome, for convenience. The values of ( $N$ ,  $n$ ) were (10, 6) and (67, 5)forthe lotteries 1 and 2 respectively. The number of outcomes used in this study were  $k= 487$ for lottery 1 and  $k = 468$  for lottery2.

Theoretically, if the numbers are drawn with replacement, the equiprobability of n-tuples of numbers can be tested using the standard chi-square test on a $N^n \times 1$  contingency table. If the numbers are drawn without-replacement, that test is not valid. A computationally intensive, modified chi-square test on a $N C_n \times 1$  contingency table is available for this scenario. However, these tests were not applicable as the observed frequencies in most of the cells were zero due to the fact that numbers of available outcomes were less than the numbers of cells in the two contingency tables. Therefore, a new and computationally simpler test was derived and applied. This test has the test statistic  $T = \sum_{i=1}^k W_i / \sqrt{k}$ , where  $W_i = (\bar{X}_i - \mu_{\bar{X}}) / \sigma_{\bar{X}}$ , with  $\bar{X}_i$  = the mean of the  $n$  numbers of the  $i^{\text{th}}$  outcome,  $k$  = the number of outcomes used in the study,  $\mu_{\bar{X}}$  and  $\sigma_{\bar{X}}$  are respectively the mean and standard deviation of the sampling distribution of  $\bar{X}$ . Since the pool of numbers from which the draws were made was known, the exact values of  $\mu_{\bar{X}}$  and  $\sigma_{\bar{X}}$  for the two lotteries can be calculated separately depending on the sampling method. The decision rule is to reject the null hypothesis of equiprobability of outcomes at the  $\alpha$  level of significance, if  $|T| > Z_{(\alpha/2)}$ . While there was not sufficient evidence to reject the null hypothesis of equiprobability of outcomes of the lottery 1, there was strong enough evidence to reject the same hypothesis for lottery 2 at 0.05 level of significance. By repeating the test for lottery 2 with partitioned data, it was found that the equiprobability of outcomes could have been doubtful during the early part of the study period.



502/E1

**Estimation of flow resistivity in polyurethane foams through measurements of normal incidence acoustic absorption coefficients**

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The normal incidence acoustic absorption coefficients (NIAAC) in the frequency range (200 Hz to 4000 Hz) were experimentally determined for commercially available polyurethane (PU) foams of densities in the range  $12 \text{ kg m}^{-3}$  to  $21 \text{ kg m}^{-3}$  and thicknesses in the range 5.08 cm to 10.16 cm using the standing wave tube according to the American Society for Testing and Materials (ASTM) Standard C384-04. Data show that NIAAC increase approximately linearly in the low-frequency range (200 Hz to 500 Hz) and vary (0.71 to 0.97) in high-frequency range (1000 Hz to 4000 Hz) of interest. The NIAAC were calculated using MATLAB based Dunn & Davern model as a function of frequency considering flow resistivity as a variable. The modeled NIAAC fitted well with experimentally determined NIAAC. It has been observed that the flow resistivity increased with increasing density of PU foams. However, no definite relationship was found between flow resistivity values and thickness of PU foam materials.



503/E1

**A study of the relationship between the sunspot number and some aspects of weather patterns in Sri Lanka using artificial neural networks**

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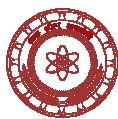
The sun plays an important role on the heating of earth's atmosphere and generating associated wind patterns. Several researches in the past have attempted to find a relationship between the solar activity and terrestrial weather in view of using it as a tool for forecasting unexpected weather changes. However, only theoretical and statistical approaches have been used at various temporal and spatial scales. Although several results have been obtained, no model is identified as reliable up to date. This study attempted to understand the influence of solar activity on monthly weather in Sri Lanka using artificial neural networks.

In this study local weather data on monthly average temperature, monthly average rainfall and monthly average sunshine hours were collected from the Department of Meteorology, Sri Lanka for a period of 600 months starting from January, 1965 to December, 2014. The sunspot number was used as an indicator of the solar activity and those data were extracted from the database of SILSO data/image, Royal Observatory of Belgium.

Data pre-processing was done with the help of MS Excel software. The MATLAB software was used for data analysis of data segmentation, constructing the supervised artificial neural network and obtaining results. Data of the first 550 months were used to create and train the neural network in capturing a relationship if exists, and the remaining data were used for testing. The accuracy of the artificial neural network was finally calculated by comparing the results generated by the network for the last 50 months of the data set with the actual collected data.

The correlation between sunspot number and the average temperature was found to be 26%, while that of the sunspot number and average rainfall was 34%. After incorporating sunshine hours, those correlations reduced to 20% and 26%, respectively. With the low accuracy levels received from the neural network for predictions, it can be concluded that there is no significant correlation between sunspot number and monthly weather patterns in Sri Lanka, an island surrounded by the ocean. Further improvements by incorporating other parameters such as solar flares and sea surface temperature of the Indian Ocean may increase the accuracy in predicting future weather patterns.

**Keywords:** Sun, solar activity, weather, neural network



**504/E1**

**Origin of life on earth: some new concepts on the probability theory**

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Probability figures published by scientists for the formation of a living cell or part thereof by conventional chemical and physical means are extremely small, almost zero. They are being quoted by some to argue that life could not have originated in this fashion. The paper explains, viewing from a different perspective, and taking into account other Earth-like planets in the Universe and beyond, that the probability could be unity (*i.e.* fully probable). Thus, if this theory is accepted, the formation of a single living cell on a single planet, on random basis, was a must. The paper argues that, origin of life did not take place on Earth as we normally understand, but rather, the planet where it originated and evolved (per Darwin's theory of evolution) into present day life, became known as Earth. The same theory shows that the probability of repetition, to form similar life forms on other planets is so small, that it is not possible for life as on Earth to exist anywhere else in the nearby universe.

The paper also describes how a second organism would have originated again based on probability. Thus a complementary link to Darwinian evolution is presented.

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## Section E2

601/E2

### FTIR spectroscopic analysis and antioxidant activities of crude polysaccharides from Sri Lankan marine algae

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Oceans cover more than 70% of earth's surface endowed with a wide diversity of marine organisms that provide a rich source of natural products. Crude polysaccharides primarily isolated from marine algae and other organisms are widely used in food, cosmetics and the pharmaceutical industry due to their broad spectrum of bioactivity with low toxicity. Antioxidant activities of these polysaccharides has become a topic of interest as these compounds play a significant role in defending the body against reactive oxygen species (ROS) that cause a broad spectrum of disease conditions. There was no previous report on characterization of polysaccharides from Sri Lankan algae. The aim of this study was to investigate the underexplored marine algae in Sri Lankan coastal waters for studying algae crude polysaccharides (CP) and to explore their antioxidant properties. Crude polysaccharide fractions obtained from the hot water extraction and ethanol precipitation of eleven Sri Lankan algae including, *Chaetomorpha antennina*, *Gracilaria corticata* var. *ramalinoides*, *Gracilaria foliifera*, *Ahnfeltiopsis pygmaea*, *Halimeda discoidea*, *Halimeda gracilis*, *Gracilaria corticata*, *Jania adhaerens*, *Caulerpa racemosa* f. *remota*, *Chnoospora minima* and *Gracilaria edulis* were analyzed for their antioxidant properties using DPPH, alkyl and hydroxyl radical scavenging and intra cellular ROS scavenging activities. Further the CPs was analyzed using Fourier Transform Infrared (FTIR) spectroscopy. The CP fraction of *C. minima* indicated the highest DPPH and alkyl radical scavenging activities with intracellular ROS scavenging activities for AAPH and H<sub>2</sub>O<sub>2</sub> induced ROS production in "Chang" cells. In fact, *C. minima* was identified as the most potent sample with high antioxidant activity and the FTIR studies revealed the principle polysaccharide present in *C. minima* as fucoidan. The degree of sulfation of these polysaccharides indicated a positive correlation with the antioxidant activity. These algae polysaccharides could be useful in pharmacological, food and in industrial applications.

Keywords: Algae polysaccharide, antioxidant activity, FTIR analysis, fucoidan, algae



602/E2

**Antioxidant activity, proximate analysis and metal ion analysis of some selected Sri Lankan marine algae**

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Marine algae are known to contain a wide variety of bioactive compounds, which have commercial applications in the medical, pharmaceutical, cosmetic, agricultural and food industries. Algae can biosynthesize a vast diversity of primary and secondary metabolites including carotenoids, phenolic compounds, phycobilins, sulphated compounds and vitamins which lead to antioxidant activity. The objectives of the current study are to explore the antioxidant activity of some randomly selected algae, two species of green algae; *Ulva reticulata* and *Dictyosphaeria versluysii*, two species of red algae; *Jania intermedia*, and *Dermonema virens* and one species of brown algae; *Sargassum natans*. In addition, approximate chemical composition and presence of metal ions in selected marine algae were investigated. Eighty percent methanolic extracts were prepared from all selected algae. Using sample stock solutions (1000 ppm), total phenol content (TPC), total flavonoid content (TFC), ferric reducing antioxidant power (FRAP), 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging activity, 2-azino-bis (3-ethylbenzothiazoline-6-sulfonic) acid ABTS radical scavenging activity (dose response: n=3) and oxygen radical absorbance capacity (ORAC) (all were screened at 100 µg/ml:n=3) were investigated. Approximate chemical analysis tests and inductively coupled plasma-optical emission spectroscopy (ICP-OES) method for metal ion analysis were conducted for *U. reticulata* and *S. natans*. Among tested marine algae, red algae *J. intermedia* showed the highest TPC ( $22.38 \pm 0.23$  mg gallic acid equivalents/g extract). Brown algae *S. natans* showed highest TFC ( $111.49 \pm 5.8$  mg quercetin equivalents/g extract), FRAP ( $1880.95 \pm 30.6$  mmol trolox equivalents (TE)/g extract), DPPH free radical scavenging activity ( $22.51 \pm 0.16\%$ ) and ABTS radical scavenging activity ( $39.64 \pm 1.72\%$ ). *J. intermedia* showed highest ORAC activity ( $82.28 \pm 10.11$  mg trolox equivalents (TE)/g of extract) followed by *S. natans* ( $68.84 \pm 6.71$  mg (TE)/g of extract). *S. natans* showed the least IC<sub>50</sub> value for ABTS radical scavenging activity ( $143.83 \pm 2.80$  µg/ml) compared to other tested marine algae. *U. reticulata* showed the highest amount of fat and carbohydrate while *S. natans* contained the highest amount of protein and dietary fiber. A comparatively higher amount of total metal ions was in *S. natans* compared to *U. reticulata*. *Sargassumnatans* can be identified as a marine algae with the highest antioxidant potential among tested algae.

**Keywords:** Antioxidant activity, ICP-OES, marine algae, secondary metabolites, pharmaceutical



603/E2

**Characterization of two heavy metal removal *Bacillus* strains from Sri Lanka into species level**

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Bacteria are organisms that have the capability to adapt to changing environments. Though the development of antibiotic resistance of bacteria has become a threat to animals including human beings, acquired heavy metal resistance and tolerance capability of bacteria is of immense benefit as they can be used in bioremediation of man polluted natural environmental bodies such as water and soil. In this study we have characterized a few bacterial strains which were isolated from industrial waste water with different heavy metal concentrations with the aim of using them in industrial waste water treatment for heavy metals. Heavy metal resistance and bio-removal capacity was determined prior to species identification. Bacterial strains were grown in Cu<sup>2+</sup>, Cd<sup>2+</sup> and Pb<sup>2+</sup> metal ion (1 mg/ L) containing LB media and metal ion removal by the bacteria per day was determined along with the growth rate. Two bacterial strains having similar Cu<sup>2+</sup>, Cd<sup>2+</sup> and Pb<sup>2+</sup> resistance were characterized morphologically, biochemically and molecularly and identified to the species level by 16S ribosomal DNA sequence analysis. The phylogenetic tree was constructed after multiple sequence alignment using Clustal W tool with the aid of MEGA7.0.14 software. Sequence comparisons were made with sequences available in NCBI database using BLAST tool after analyzing the sequences using BioEdit software v7.1.11. Two bacterial isolates TWSL-10 and TWSL-7 showed 83.685 ± 1.152% and 92.091 ± 0.361% Cu<sup>2+</sup> ion removal capacity while Pb<sup>2+</sup> removal capacity were 93.101 ± 0.803% and 97.257 ± 0.627 % after the 7<sup>th</sup> day of inoculation. The Cd<sup>2+</sup> ion removal of the strain TWSL-7 was 83.859 ± 0.906 % while it was 63.101±0.416% for the strain TWSL-10. Strain TWSL-7 showed 99% homology to the 16S rDNA sequences of both *Bacillus marisflavi* while TWSL-10 showed 99% homology to *Bacillus aquamaris* sequences available at NCBI. Strains TWSL-7 and TWSL-10 were confirmed as *Bacillus marisflavi* strain TWSL-7 (Accession number: gb|KR027925.1) and *Bacillus aquamaris* strain TWSL-10 (Accession number: gb|KT184891.1), respectively, based on molecular and morphological characteristics and their sequences were deposited in the NCBI database.

**Keywords:** 16S rDNA, *Bacillus*, bioremediation, industrial waste water, metal resistance

**Acknowledgement:** Financial assistance by NSF Research grant (RG/2011/BT/08)

604/E2

### Lupeol acetate as a prodrug in wound healing

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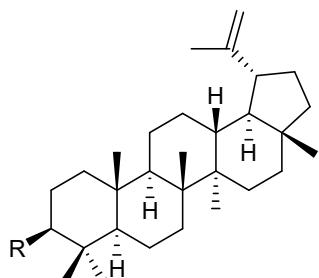
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Lupeol was shown to be active in healing wounds on animal cell culture models, Madin-Darby Canine Kidney (MDCK) cells and Baby Hamster Kidney (BHK-21) cells while lupeol acetate was found to be significantly less active under the same conditions. It was also observed that lupeol acetate was capable of increasing wound healing activity with time in both cell lines. Prompted by this observation we investigated whether lupeol acetate acts as a pro-drug being hydrolyzed into lupeol in the vicinity of the wound. Lupeol acetate was incubated in the presence of cells with a wound and in the absence of cells and the medium was tested for the presence of lupeol by Thin Layer Chromatography (TLC) with time while simultaneously monitoring the wound healing activity using scratch wound assay (SWA). Asiaticoside, a potent wound healing agent was used as the positive control. The widths of the wounds at different time intervals (0 h, 24 h, 36 h, and 48 h) were measured and the percentage wound closure calculated.



Lupeol                  R = OH  
Lupeol acetate      R = OAc

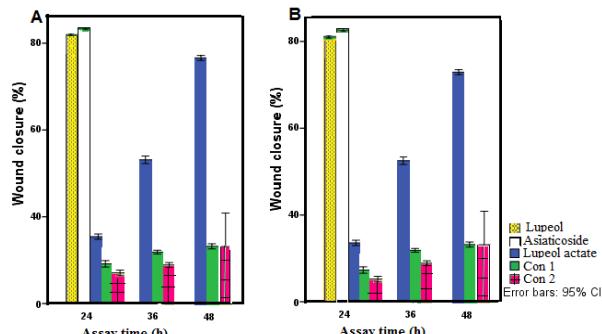


Fig. 1: % wound closure in the presence of lupeol acetate with time compared with lupeol and asiaticoside. (A) BHK cell line. (B) MDCK cell line.

SWA results confirmed that lupeol acetate increased the wound healing activity with time (Fig.1) while comparative TLC examination of the two assay media revealed that, lupeol acetate has been hydrolyzed to give lupeol in the presence of the cells while no change has occurred in the absence of cells. Thus, it can be concluded that lupeol acetate act as a pro-drug in the vicinity of cells by producing lupeol at a low concentration.

Acknowledgment: Financial support from Link Natural Products (Pvt) Ltd and Faculty of Natural Science of the Open University of Sri Lanka.



605/E2

**Amylase production by *A. niger* under solid state fermentation using passion fruit peel as the carbon source**

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Enzyme amylase possesses diverse applications in a wide variety of industries such as food, fermentation, textile, paper, detergent and pharmaceutical. With the advent of new frontiers in biotechnology, the spectrum of amylase application has expanded into many other fields, such as clinical, medicinal and analytical chemistry. Although amylases can be derived from several sources, including plants, animals and microorganisms, microbial enzymes generally meet industrial demands. A wide range of micro-organisms such as bacteria and fungi namely *Aspergillus* and *Trichoderma* sp are used for the industrial production of amylases.

In the present work amylase enzyme was produced by *Aspergillus niger* under solid state fermentation using passion fruit peel as the carbon source. The culture conditions for maximum amylase production were optimized by varying the incubation period, pH, inoculum volume and concentration of carbon source. Enzyme produced under optimum conditions was purified by ammonium sulphate fractionation followed by ion exchange chromatography. The partially purified enzyme was assayed varying the pH and incubation temperature to determine optimum pH and incubation temperature for the enzyme. Amylase activity was assayed using starch-iodine method.

The maximum activity was shown after 6 days of fermentation at pH 5.0. Optimum level of inoculum and concentration of carbon source were found as 2.00 mL (~spores $1\times 10^4$ /mL) and 40% (w/v) respectively. Amylase enzyme was partially purified (2.3 fold) by ammonium sulphate precipitation followed by ion exchange chromatography. Optimum pH and optimum incubation temperature of this partially purified enzyme was found as pH 7.0 and 70 °C, respectively. The results of this study revealed that passion fruit peel powder can be utilized as the carbon source for production of amylase enzyme with a yield of 7870 unit/g. Optimum activity of the enzyme at temperature as high as 70 °C reveals that it can be exploited in the starch processing industry. Lower substrate cost and higher yield offer the potential for inexpensive production of amylase, making the process industrially and economically feasible.

**Keywords:** Amylase, *Aspergillus niger*, passion fruit peel, solid state fermentation



606/E2

**Selection of an efficient n-hexadecane degrading fungal-bacterial community**

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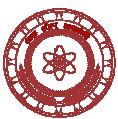
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Recalcitrant organic substances are a major environmental pollutant. Microbes such as *Pseudomonas*, *Acinetobacter*, *Rhodococcus*, *Bacillus*, *Aspergillus*, and *Penicillium* have been identified as agents that have the ability to degrade these organic pollutants. In nature, synergism plays an important role where it leads to the persistence of organisms in various habitats. Bacteria capable of growth on hexadecane were isolated from Meethotamulla garbage dump, Western province. During subsequent culture in hexadecane-containing medium, three isolates were observed to form a fungal-bacterial community. Visual disintegration of the hexadecane layer was observed to be more efficient in the fungal-bacterial communities compared to the single bacterial isolates. Therefore, these three communities were selected for further analysis. The three communities were grown on Bushnell and Haas medium supplemented with 1% (v/v) hexadecane as the sole source of carbon, at 40°C for 14 days. Residual hexadecane was extracted into hexane and the extract was analyzed by gas chromatography/mass spectrometry. All assays were conducted in duplicate. Hexadecane biodegradation by the three fungal-bacterial communities, FBC1, FBC2, FBC3 were found to be 99%, 74% and 98%, respectively. FBC1 was selected for further analysis. It was grown on both nutrient agar and Sabouraud dextrose agar in order to isolate the bacteria and fungi respectively. The community comprised of a single bacterium and a fungus. Identification of microbes was performed by microscopic, biochemical and molecular techniques. Gram's staining and biochemical tests based on Bergay's manual indicated the bacterium was *Bacillus* sp. 16s rRNA gene sequencing identified the bacterium as *Bacillus cereus* / *B. thuringiensis*. Microscopic observations via slide culture technique indicated the fungus to be *Aspergillus* sp. These results suggest that FBC1 is a potential bioremediation agent to remediate hydrocarbon contaminations.



607/E2

**Investigation of the quality of coconut oil available at retail and wholesale shops in the coconut triangle**

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There is an opinion that coconut oil sold at the market is adulterated with other cheaper vegetable oils. Quality of coconut oil can deteriorate due to improper handling of raw materials and storage conditions. The objective of this study was to determine the quality of coconut oil available at retail and wholesale shops in Kurunegala, Colombo and Puttalam districts. Coconut oil samples were collected using simple random sampling from wholesale and retail shops. Samples were collected from 10 wholesale shops and 33 retail outlets which included 12 from Colombo, 12 from Kurunegala and 9 from Puttalam districts. Quality parameters were assessed by determination of moisture, free fatty acids (FFA), peroxide value, relative density, refractive index (RI) and colour using SLS standard methods and compared with Sri Lankan Standard values. Three replicates from each sample was carried out. Adulteration was determined by the iodine value (SLS313: Part 2-Section 2:2009). The iodine value (IV) of the samples varied from 6-49 and the 40% of the samples collected from wholesale shops exceeded recommended level of IV (more than 11) indicating that the 40% of samples were adulterated. Further, 60% of samples collected from retail shops were adulterated while 92 % of samples from the Colombo District were adulterated. Results showed that 36% samples from retail shops and 20% samples from wholesale shops exceeded the limit for FFA (0.8% as lauric acid). Formation of peroxide was observed in 60% of samples collected from wholesale and 78% from retail shops. High moisture contents than the SLS limit of 0.4% were observed in 30% from wholesale and 33% in retail shops. Colour of 51% from retail shops were higher than the limit of 4. However, RI of all samples from the wholesale and retail shops were higher than the limit of 1.4492. Relative density of 44% from retail and 70% from wholesale were within the limit. Quality of most coconut oil samples collected from the retail and wholesale shops in Kurunegala, Colombo and Puttalam districts did not comply with the Sri Lankan Standards for Coconut oil 32:2002.

**Keywords:** Cococnut oil, adulteration, quality, iodine value, peroxide value, free fatty acids



608/E2

**A computational study for the Identification of lead compounds from Sri Lankan flora to treat selected neurodegenerative diseases**

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Taxonomy of neurodegenerative diseases (ND) such as Alzheimer's disease (AD), Parkinson's disease (PD) is onerous due to the multifaceted etiology. These disabling illnesses cause immense emotional, physical and economic burden on society hastening the need of disease management. Gathering evidence declares that protein aggregation and oxidative stress mediated by metal accumulation are considered as the major factors involved in neurodegeneration. Since transmutation of metal homeostasis is the rhizome, chelation therapy would be a worthwhile strategy. Thus, potential chelators for the metal ions zinc and aluminium are identified via computational approach to use as lead compounds from an existing database of chemical compounds identified from Sri Lankan flora (<http://science.cmb.ac.lk/tools/slflora/>) to alleviate the neurological problems.

Aluminium ( $\text{Al}^{3+}$ ) and zinc ( $\text{Zn}^{2+}$ ) complexes were analyzed using umbrella sampling, one of the advanced methods of molecular dynamics that provide the difference in free energy between two states of a molecular system along a reaction coordinate to overcome rare events of sampling in configuration space by restraining the simulation system with harmonic potential. The reaction coordinate is the distance between the center of mass of the ligand and the metal ion. The standard technique weighted histogram analysis method (WHAM) was employed to compute the potential of mean force which is freely available with the GROMACS software package in the LINUX operating system.

Appraisal of the free energy calculations implied that the compounds 2,5-dihydroxy-1,6-dimethoxyxanthone, isoshinanolone carry substantial potential to bind  $\text{Zn}^{2+}$  and  $\text{Al}^{3+}$ , respectively, related to reference values. Furthermore, binding units of 1,7-dihydroxy-3-methoxyxanthone with  $\text{Zn}^{2+}$  and  $\text{Al}^{3+}$  shows the binding functionality into a single compound. Therefore, these compounds screened using computational endeavour, will set the path for drug design for the treatment and investigation of ND, reducing the wastage of chemicals.

Figure. Structures of 2,5-dihydroxy-1,6-dimethoxyxanthone, isoshinanolone, 1,7-dihydroxy-methoxyxanthone, respectively

Keywords: free energy, metal chelators, umbrella sampling, WHAM



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**Electrocatalytic activity of nanocubic and microcrystalline Cu<sub>2</sub>O electrodes for glucose oxidation**

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Nanostructured metaloxides have been extensively explored as sensors with high sensitivity, fast response, and good stability for the determination of glucose by electrochemical oxidation. This study reports the fabrication of nanocubic Cu<sub>2</sub>O and microcrystalline Cu<sub>2</sub>O films on Ti substrates using a pH controlled acetate bath, their characterization and performance as an electrochemical glucose sensor. Electro deposition of Cu<sub>2</sub>O films was accomplished in an aqueous acetate bath (0.1 M sodium acetate and 0.01 M cupric acetate at pH=6). Conditions were optimized to obtain *p*-type Cu<sub>2</sub>O nanocubes having well defined edges with dimensions around 300 nm. These films changed their conductivity to *n*-type upon annealing (200°C, 1h). These were then used as templates to grow thicker *n*-type films with an agglomeration of a large number of nanocubic Cu<sub>2</sub>O crystals. Resulting films were used as electrodes for amperometric determination of glucose. Topographical properties of the deposited films were analyzed by scanning electron microscopy (SEM), which revealed the presence of a well defined nanocubic structure. The electrocatalytic activity for glucose oxidation of these films was compared with that of the microcrystalline Cu<sub>2</sub>O films having grains of arbitrary shapes. The structure and the phase purity of the Cu<sub>2</sub>O films were characterized by X-ray diffraction (XRD) and no impurities were detected. Impedance measurements were used to determine the type of the conductivity of the films. Cyclic voltammograms of the Cu<sub>2</sub>O electrodes were obtained in 0.1 M NaOH solution. A clear peak for the oxidation of glucose was observed in the case of nanocubic material. No such clear glucose oxidation peak was observed for microcrystalline material. Chronoamperometry was utilized to ascertain the effect of working potential on the electrocatalytic oxidation of glucose over nanocubic and microstructure Cu<sub>2</sub>O electrodes. Successive addition of 0.1 mM glucose at the applied potentials ranging from 0.2 V to 0.6 V showed that the maximum current is obtained at 0.5 V. However, a wider linear detection limit was observed at 0.6 V which is 2 µM to 20 µM. The nanocubic electrode showed a sensitivity of 2937 µAmM<sup>-1</sup>cm<sup>-2</sup> whereas the microcrystalline electrode showed a sensitivity of 1882 µAmM<sup>-1</sup>cm<sup>-2</sup>.



610/E2

**Natural rubber/ scrap rubber and 4-tert-butylstyrene/isodecyl acrylate semi-IPN systems as novel oil absorbents**

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Need of an excellent oil-absorbent is indispensable for todays' world for oil spill cleanup as it has become a prominent environmental pollution pathway. This research highlights the use of a novel semi-Inter Penetrating Polymer Network (IPN) polymeric materials based on natural rubber (NR)/ scrap rubber (SR) with 4-tert-butylstyrene (tBS) / isodecyl acrylate (IDA) as a sorbent for an oil spill cleanup. In this research divinylbenzene (DVB) was used as a cross-linking agent and benzoyl peroxide (BPO) was used as an initiator. A series of IPN systems was synthesized and oil absorbency and oil retention capacity in toluene and four different oils (diesel, petrol, automobile discard oil and coconut oil) were determined. Highest Oil absorbency values for synthesized semi IPN systems are shown in Table 1.

Table 1: The highest oil absorbency values of semi IPN systems

Semi IPN system	Absorbency percentage (w/w *100)
NR:4-tBS:DVB (50:50:1)	1051.0% in toluene , 543.0% in diesel
NR:4-tBS:DVB (50:50:4)	241.9% in toluene , 375.9% in diesel
SR:4-tBS:DVB (30:70:4)	266.0% in coconut oil
SR:4-tBS:DVB ( 30:70:1)	58.9% in coconut oil
SR:4-tBS:DVB (10:90:4)	112.7% in toluene
SR: IDA : DVB (10:90:4)	287.1% in toluene

Oil absorbency decreased with increasing DVB concentration and increased with the amount of NR. Oil absorbency increased with increasing soaking time while the rate of oil sorption decreased. NR is efficient in absorbing light to moderately viscous oils and less effective in absorbing highly viscous oils.

Selection of NR/SR as the core polymer of the absorbent is a worthwhile endeavour as it is highly abundant in South Asia, sustainable and also economically profitable compared to the synthetic petroleum based polymers.



611/E2

**Sorption behavior of fluoride ions on iron-magnesium-cerium tri-metal composite**

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Weathering of fluoride rich rocks and industrial processes such as electroplating and glass manufacturing result in accumulation of fluoride in natural water bodies. Fluoride is an essential micro nutrient to humans and animals in many aspects namely, strengthening of bones, prevention of tooth decay, and regulating the human growth rate. The acceptable level of fluoride in drinking water is 1.5 mg/L as recommended by the World Health Organization. However, the recommended level of fluoride for tropical countries such as Sri Lanka is 1.0 mg/L. Excess amount of fluoride ions in drinking water causes health risks such as skeletal and dental fluorosis, cancers, infertility and thyroid disorder. In general, the drinking water sources in the intermediate and dry zones in Sri Lanka are rich in Fluoride. Therefore, millions of lives are at the risk of developing fluoride developing diseases. Therefore, removal of fluoride ions from drinking water has gained much attention of the research community.

A wide variety of novel adsorbents have been developed to remove fluoride ions from aqueous medium. In this work 1:1:1 ratio of tri-metal composites of Fe-Mg-Al, Fe-Mg-Zn, Al-Mg-Ce and Fe-Mg-Ce were synthesized using co-precipitation method for the removal of fluoride ions from aqueous solutions with the efficiency (the amount of fluoride ions adsorbed per unit) of  $0.275 \pm 0.01$ ,  $1.496 \pm 0.259$ ,  $2.016 \pm 1.553$  and  $2.554 \pm 0.0079$  mg/g, respectively. As reported above, the highest amount of fluoride adsorbed per unit of fluoride ions was observed for the Fe:Mg:Cetri-metallic composite. Therefore, further studies were carried out to improve its efficiency by varying the solution pH, contact time and the molar ratios of metals in the composite. The adsorption process was highly pH-dependent. The maximum amount of fluoride adsorbed per unit of the Fe-Mg-Ce tri-metal composite was determined to be 48.31 mg/g at pH 7. Rapid adsorption of fluoride was observed within the first sixty minutes and equilibrium was established within 5 hours. The fluoride removal efficiencies for Fe:Mg:Ce composites with molar ratios of 1:1:1, 1:1:2, 1:2:1 and 2:1:1 were  $2.550 \pm 0.008$ ,  $48.310 \pm 0.079$ ,  $17.230 \pm 0.263$  and  $23.380 \pm 0.090$  mg/g at pH 7.00 respectively. These composites were further studied using FT-IR techniques and XRD.

**Acknowledgement:** Financial assistance by the University of Sri Jayewardenepura, research grant ASP/01/RE/SCI/2015/31



612/E2

**Effect of emulsifiers on stability of ice cream: identifying best emulsifier and stabilizer blend**

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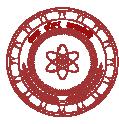
Emulsifiers are being added to ice cream in order to maintain the emulsion of the ice cream mixture, to make the ice cream smooth and easy to handle, and to increase its resistance to melting. Therefore, the present study was design to investigate the effect of different emulsifiers (mono & di glyceride (MDG), polysorbate 80 (P80), the mixture of polysorbate 80 and mono & di glyceride (80: 20) and lecithin) on stability of an ice cream mixture and finally to select the best emulsifier and stabilizer blend for the ice cream manufacturing process.

Samples were prepared using four different emulsifiers that were analyzed for physico-chemical (melting properties, fat, total solids, appearance and overrun) and sensory characteristics. The mixture of MDG and P80 incorporated ice cream had the highest melting resistance while lecithin incorporated ice cream the lowest melting resistance. Overrun, total solids percentage and fat percentage were significantly affected ( $P<0.05$ ) by the treatments. Physicochemical parameters (overrun, total solids and fat) revealed that the mixture of MDG and P80 was the best emulsifier which can be used for emulsifying ice cream. Better appearance was shown by the ice cream prepared using a mixture of MDG and P80 when compared with the other three emulsifiers. On organoleptic evaluation the highest scores were awarded to the lecithin incorporated ice cream while the lowest scores were awarded to the P80 incorporated ice cream. It was found that different emulsifiers affected the texture and the quality of the ice cream.

Kelgum (MDG = 0.3%), Ice pro (propane-1,2-diol = 0.3% & MDG = 0.15%) are some of the emulsifier and stabilizer blends which are mainly used in the ice cream industry. Heat shock treatment was tested for Kelgum and Ice pro. Following heat shock treatment, samples were evaluated by paired comparison for sensory properties and physical appearance.

Following heat shock and paired comparison sensory evaluation, the highest scores were awarded to the Ice pro incorporated ice cream followed by the Kelgum incorporated ice cream. In conclusion the physical appearance of the Ice pro incorporated ice cream was better than that with Kelgum, due to the smoother texture, low ice crystal formation and taste.

**Keywords:** Overrun, heat shock, organoleptic evaluation, stabilizer, Kelgum, Ice pro



## Section E3

701/E3

### An android based live tour guide for Sri Lanka

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Tourism is one of the main industries that generate a high income for Sri Lanka. Even though it plays a crucial role in the attainment of macroeconomic stability, during the past few years a significant decrement in gaining foreign currency is implied. Dissatisfaction among tourists stems due to lack of honesty and loyalty of the Sri Lankan people. While mobiles were used only for the voice communication in the past today the scope has changed immensely. Currently most use mobiles for web browsing as well as for the Global Positioning Services (GPS). In order to develop a solution for the identified problems related to the Tourism industry with the enhancement of technology a "Live Tour Guide" application was developed. This application provides the distance as well as the estimated time to reach the destination from the point of origin when there is no traffic. Apart from that it gives details regarding the places of interest and the hotels located along the desired travelling route. By using those details the tourists will be able to plan out their journey before they reach Sri Lanka. Any user who is equipped with an android based smart phone is eligible to use this application. Apart from the mobile application, a separate web site is available in order to make it easy to maintain the database which contains all the information regarding the locations. The entire data can be stored in the database very easily and accurately by using the "Live Tour Guide" website. The web site can be used by a particular agency, and the tourists will be able to enjoy the benefits of this "Live Tour Guide" mobile application. Finally this application could have a positive impact on the Sri Lankan economy as well as on the tourism industry.



702/ E3

### Context aware smart medicine wallet

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This study describes the design and the prototype development of a system that allows storage of medicine, and to examine and react to an individual medicine wallet user's changing context.

To obtain the maximum benefit from prescribed medication, it is important to take these exactly as prescribed by the doctor. In fact, this improves the chance of a better health outcome. However, some individuals do not take one or more of their prescriptions according to their doctor's instructions. If a user has to take one or more drug types such as tablets, capsules, syrups, creams etc. the user needs to remember the specific drug, the time of the day, and the dosage, which is inconvenient. Context Aware Smart Medicine Wallet is a medicine keeping wallet which addresses the above mentioned problem. The medicine wallet is designed to be expandable so that the wallet can be adjusted based on the number of medicines a user takes and is accessible, usable and portable. If a user forgets to carry the medicine wallet to office, it automatically identifies it and notifies the user to carry it and also helps to locate the wallet. Medicine wallet establishes communication with the smart phone via Bluetooth technology. In order to maintain the medical storage environment, temperature sensors have been used and the materials to be used in insulating the medicine as recommended for the commercial product have been proposed. As a result the heat generated from the circuits would not affect the medicine. Furthermore this paper discusses the results of a survey on reasons for not taking medicine at the correct time, different types of medicine taken by patients and the reminder techniques the patients had used over a period of time. The paper discusses the critical decisions taken when designing the wallet, alternative designs, the implemented prototype and the mobile application developed.



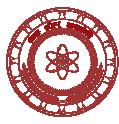
703/ E3

### **“OffOptimizer” - Optimal quotation planning for the offset printing industry**

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Human beings have diversified communication modes and among them print media has become one of the main modes for mass communication. Although there are many methods of printing, offset printing is identified as the most cost effective method for large quantity. Usually, the customer either provides the idea of the printing work or the artwork to the Printer. These print orders involve different types of printing including books, banners, leaflets etc. The printing task is challenging when it involves printing of different shapes with varying colours as the printer has to give the most economical quotation for the customer and earn a profit while providing an efficient and a quality service. In the medium and small scale printing industry, quotation preparation is usually done manually. The best quotation for the printer is the one that maximizes the number of shapes that can be cut from a given paper size. This involves many calculations mostly done manually, by skilled estimators which is a tedious as well as a time consuming job. Literature and a market survey revealed that the manual preparation of quotations is a significant barrier in the development of the medium and small scale printing industry. The project “OffOptimizer” presented in this paper address these limitations in the offset printing industry by providing an automated web based software solution. Hence the aim of this project is to implement a software system that can be used to efficiently generate a cost effective quotation for any given design pattern by optimizing the analysis phase. The inputs to the system are the image to be printed, the size of the paper and the quantity required. The softcopy of the input print matter is given in a white background and this print matter is converted to a web DPI (dots per inch). Following the DPI converting process the system makes new images by placing the print matter in different angles to decide the maximum number of shapes that can be cut from each angle. At this point a human can make the decision on what is the best angle to cut the shapes or else choose the advanced option to enable developing of the tessellation by mixing different angles. Once the most suitable model is identified the system will calculate the cost according to the given paper size. Given the input parameters the OffOptimizer is able to suggest the most suitable type of printing machine *i.e.* two-colour, four-colour etc. out of the available machines. The total solution for a given job is saved for repeated work. The user acceptance of the final system is 87% for efficiency, accuracy, user friendliness, and cost effectiveness.



704/E3

### **Effectiveness of digital poetry**

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E-Literature is, rapidly advancing Information Technology field's contribution to literature, and digital poetry is its poetic aspect. Digital poetry is where multimedia, software and computer programming are distinctively used in the composition, generation, or presentation of a poem. Digital poetry is a budding trend in both the fields of information technology and literature. However, whether digital poetry fulfils the basic purpose of a poem by arousing emotions and conveying the actual meaning like a textual poem is a question. Thus, this research finds the effectiveness of digital poetry by taking into account its purposes of arousal of emotions and conveying of precise messages. Brain Computer Interface was utilized for the experiment and the signal capturing was done through Electroencephalogram (EEG). The effectiveness of digital poetry was measured against effectiveness of textual poetry by using short digital poems and their textual versions. According to the results, textual poetry is more effective than digital poetry. The results of this research would be beneficial for both the fields of Information Technology and Literature.

**Keywords:** Digital poetry, textual poetry, brain computer interface, electroencephalogram



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705/E3

**User stories, epics in agile methods vs use case models in unified modeling language**

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The objective of this study was to compare user stories and epics with use case models, for the purpose of transformation. While our overall focus was on modular transformations and ontologies, for this study we focused on a specific form of modular transformations, which arose due to the extremely rapid developments in the software engineering field, which led to the emergence of the agile development processes, such as Extreme Programming (XP), Scrum, Kanban, Scrumban, Crystal, Lean, etc. User stories and use case models are two of the most popular requirement analysis documents used in Sri Lanka according to a survey of the techniques used in software engineering. Both user stories and use case models are techniques used in requirement gathering during software development. A difference between them is that while user stories are used in agile methods, use case models are part of unified modeling language (UML). While many experts refused to recognize any connection or compatibility between the two techniques, we recognized and concluded that use case models relate to user stories through epics, which are at the same time both large user stories, and collections of smaller user stories. We surveyed a sample of about 100 user stories on the internet, and 56 of them which followed the format defined in the traditional user story template had roles which matched actors in use case models, and goals / desires which matched the use case. Due to this matching between elements of user stories / epics and between use case model elements, we were able to design a software prototype to transform roles and goals / desires of epics into actors and use cases of use case models. As an example, when an epic or user story such as "As a Manager I want to view Reports so that I can manage my branch" is given as an input to our software prototype, it generates a use case model where the actor is "manager" and the use case is "viewreports".



706/E3

### **Uniform, multi-landscape technology-independence and interoperability in the HL7 development paradigm**

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Information technology services and allied infrastructure have become a veritable fixture in healthcare provider facilities worldwide. Cutting-edge, superlative, smart computer systems have been complemented with commensurate regulation and standardization processes, across geographical and socio-economic boundaries, maximizing the Return-On-Investment (ROI) from such ventures. Semantic Interoperability (SI) which is the meaningful exchange of healthcare information with homogenous understanding amongst participating enterprises, is therefore the key. Extrapolated to a universal sense, it is termed herein as International Interoperability. Health Level Seven (HL7) v3 is a global healthcare standard which supports SI. It consists of an upper ontology, Reference Information Model (RIM), and the three paradigms of messages, Clinical Document Architecture (CDA), and services. The upper ontology consisting of functionally-diverse sub-ontologies, is HL7's foundational structure. The RIM is the encyclopedic reference for the vocabulary schema in all HL7 implementations. The current manifestation v3 of HL7 however, is difficult to implement and maintain. Core design and operational issues have arisen from the newly-inserted RIM. These logical and ontological flaws have affected efficient, compliant system implementations. Poor-calibre finalized specifications have led to difficult system implementations. Compounding the problem is the non-uniformity in the modelling vocabulary. The upper ontology is represented in Web Ontology Language (OWL), whilst the RIM and the three paradigms are modelled using the Extended Markup Language (XML). This multiplicity, non-uniformity, and wordiness in representation of linked phases of the development process results in a segmented vocabulary universe, requiring translation at the various interfaces. Inter-phase interoperability, stakeholder communication, quality of specifications generation, and overall development efficiency are all affected. The principle objective of this research therefore was to infuse overarching uniformity and brevity in the utilized vocabulary, extending across multiple developmental landscapes. Our proposed solution remodels all OWL and XML artifacts using the proposed, techno-platform independent Unified Data Atom (UDA+) representation, either first-hand or as a single-step transliteration, creating overarching homogeneity across all five HL7 landscapes. The UDA+-modelled artifacts achieve true inter-phase interoperability promoting high-quality specifications development. They exhibit simplicity, brevity, and versatility over the previous representations. Principally significant is that analysis and design interoperability amongst all stakeholders also derived actualizing overarching, ubiquitous exchange.



## Section F

801/F

### **Introduction of content and language integrated learning activities for secondary bilingual science teachers as a supportive measure**

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Content and language integrated learning (CLIL) is a world accepted bilingual teaching methodology. The CLIL was introduced to the education system in Sri Lanka nearly three years ago. CLIL is an interwoven process where teachers see an integration of both the language and the content. A CLIL teacher is not simply a subject teacher who delivers the subject content in English. In Sri Lanka well programmed special training is not yet available to the bilingual teachers. At the same time Education sector development framework and programme introduced by the Ministry of Education heighited the importance of using school based teacher development (STD). Therefore, the main purpose of this study was to research into how CLIL methodology is employed by teachers in teaching science. It also attempted to equip the teachers with the relevant skills of using CLIL methodology through STD. The sample consisted of 15 science bilingual teachers from the Negombo Education Zone. This study was designed as an Action Research Mode. Fact finding was done using observations and semi structured interviews revealed that the teachers did not know sufficiently both the pedagogical and practical knowledge of using CLIL. Thus an intervention was designed to train them to prepare CLIL activities. The activities were developed combining language components. Following the implementation teachers realized the need to continue preparation of CLIL activities and requested an activity guide book. Content analysis was used to analyze the activities, lesson plans, teacher's reflections. Though the findings revealed that the teachers lacked both theoretical and practical knowledge of CLIL, the workshops done based on the STD programme enabled the teacher to acquire a fairly good knowledge and practical aspects of CLIL. All the teachers showed a marked improvement of CLIL methodology. The results also revealed that school-based teacher development is more beneficial for bringing in the necessary changes in teachers. Further research in the area is required for introducing a CLIL model based on socio cultural milieu of the Sri Lankan society.

**Key words:** CLIL, CLIL activities, school based teacher development programme,

**Acknowledgement:** Financial assistance by the Higher education for the Twenty First Century (HETC) Grant QIG Windows 3 (Postgraduate Research)



802/F

**Impact of work place stress on job performance: science graduates in selected semi-government scientific organizations in Sri Lanka**

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Work place stress is ubiquitous and has an impact on employee's job performance. Most countries are becoming more familiar with this phenomenon and how to manage it. The main purpose of the current study was to identify the main causes of work place stress, the level of stress with regard to each dimension and all dimensions and relationship between work place stress and job performance of science graduates in semi-government science and technological organizations in Sri Lanka. The survey covered 115 (20%) of 502 science graduates in five semi-government science and technological organizations. Data were collected by using a questionnaire which consisted of 51 questions with respect to work place stress and job performance.

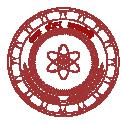
Each organization was considered as a cluster and the questionnaire was administered to all members in their respective head office. A total of 115 usable questionnaires were retuned, yielding a response rate of 97%. Statistical analysis showed a positive relationship between work place stress and job performance. The Cronbach's alpha test was done to ensure the reliability aspects of the instruments. The validity aspects were ensured by the conceptualization of variables based on literature and correlation analysis. As the univariate analysis, the frequency distribution was made for every variable in the research model and for personal characteristics. As the variable analysis, the correlation and simple regression analysis were made. The results matched with inverted U curve area which related to a moderate stress level. The results indicated the stress level of science graduates working in science and technological semi-governmental organizations of Sri Lanka was 3.0295 (some stress level). The lowest stress was due to physical demand (2.8461) and the highest stress was due to task demand (3.3768). Their Job performance was at a good level (3.86). When all dimensions were considered together, the relationship between work place stress and job performance showed a positive correlation ( $r=0.346$ ) at a 0.01 significance level.

Stress level of science graduates in semi-governmental organizations needs to be monitored regularly to gain maximum benefit from this human resource.

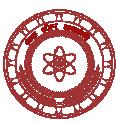
**Keywords:** Work place stress, job performance, science graduates, semi-governmental organizations

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## *Poster Presentations*



**901/A/Poster**

**Entomological and sociological risk factors affecting transmission of dengue in the Gampaha District, Sri Lanka**

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At present, dengue is one of the most important mosquito-borne viral infections in Sri Lanka. The second highest number of dengue cases was reported in the District of Gampaha. The objective of the study was to investigate the possible risk factors affecting transmission of dengue in the Gampaha District.

The study was conducted in four dengue high-risk Medical Officer of Health (MOH) areas, namely Kelaniya, Mahara, Negombo and Wattala where the annual reported number of dengue cases were greater than 300. In each MOH area one *Gramma Niladari* (GN) division was selected. Mirigama MOH area was selected as the control area. A cluster of 150 house-holds were selected in study and control areas. House-hold, sociological and entomological surveillance were performed and data were analyzed using Chi-Square test at 5% level of significance.

There were 3,125 individuals in all study areas and 80.8% (n=2525) of them lived in dengue high-risk areas. The average size of the homestead was significantly different ( $\chi^2=63.95$ ,  $p<.0001$ ) in dengue high-risk areas (20.8 perches) with the control area (40.7 perches). The main waste disposal method in dengue high-risk areas was collecting trailers of municipal councils (79.3%, n=476) while collecting and burning (98.7%, n=148) was the main waste disposal method in the control area. More than 88% of house-holds in study areas were using at least one mosquito preventive measures and use of bed-nets (74.6%, n=560) was the most popular measure.

A total of 4,238 potential breeding sites were inspected of which 81.5% (n=3,454) were reported in dengue high-risk areas. Of the 63.1% (n=2,180) water filled containers, 13.1% (n=285) were positive for dengue vector mosquitoes in study areas. In the control area, there were 61.9% (n=485) of water filled containers, of which 11.5% (n=56) were positive for dengue vector mosquitoes. A total of 1,105 adult dengue vector mosquitoes were captured, of which 96.3% (n=1064) were *Ae. albopictus*. There was significant associations between size of the homestead ( $\chi^2=63.95$ ,  $p<.0001$ ), type of houses ( $\chi^2=911.47$ ,  $p<.0001$ ), surrounding cleanliness ( $\chi^2=68.17$ ,  $p<.0001$ ), vegetation cover ( $\chi^2=116.86$ ,  $p<.0001$ ), potential breeding sites for *Aedes* larvae ( $\chi^2=69.82$ ,  $p<.0001$ ), number of positive containers ( $\chi^2=34.54$ ,  $p<.0001$ ), and number of field caught dengue vector mosquitoes ( $\chi^2=67.55$ ,  $p<.0001$ ) with the homesteads having confirmed dengue cases. Potential risk factors maybe, small households and homesteads, poor waste management system and unwillingness to pursue preventive measures. Therefore, attention should be paid on implementing better waste management systems together with community participation.

**Keywords:** dengue breeding sites, risk factors for transmission

**Acknowledgement:** Financial assistance by the National Research Council (NRC-TO-14/04)



**902/A/Poster**

**Knowledge, attitude and practices (KAPs) based risk factors for dengue in the Gampola Medical Officer Health area, Kandy District, Sri Lanka**

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Dengue is a major health issue in Sri Lanka, with 29,777 cases reported in 2015. Knowledge, attitude and practices (KAPs) directly influence the susceptibility of a population to dengue. Therefore, the current study was conducted to identify the potential risk factors for dengue in terms of KAPs in the Gampola Medical Officer of Health (MOH) area in the Kandy District.

A descriptive study was conducted from randomly selected dengue cases reported (n=200) and non-reported (n=200) households. Information relevant to KAPs were collected via a structured questionnaire. Paired-Chi square test was used for data analysis.

A majority of the healthy population had a high awareness level on dengue (47.5%, n=95) in contrast to the dengue infected population. Both populations were willing to further improve their awareness on dengue, especially in terms of controlling vector breeding sites ( $p<0.05$ ). High proportion of the healthy households were practicing source separation of waste, home gardening and composting than the infected population ( $p<0.05$ ). Cleanliness of households of both groups remained high (94.5%, n=187 and 92.5%, n=185, respectively). Waste collection by the Municipal Council (MC) and open burning were observed as the predominant practices in both groups, while the frequency of waste disposal by the residents remained <7 days. Use of bed-nets, mosquito coils and creating smoke remained as preferred methods for prevention of mosquito bites in both populations. When considering the community participation in controlling dengue, 87.0% (n=174) of the healthy population were willing to extend their support in contrast to the 64.0% (n=128) of the dengue infected group ( $p<0.05$ ). Significant variations in awareness on dengue, solid waste disposal methods, practicing of source separation of waste, home-gardening/ composting, prevention methods of mosquito bites and community participation were noted among the two populations ( $p<0.05$ ). Therefore, above aspects could be recognized as key areas to focus on by the relevant authorities to facilitate community based dengue vector management in the Gampola MOH area in the Kandy District.

**Keywords:** Dengue, Knowledge, Attitudes and Practices (KAPs)

**Acknowledgement:** Financial support by the National Research Council Dengue Mega Project (NRC TO 14-04)

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903/A/Poster

**Cloning of endoxylanase 23 (*exn23*) gene of *Trichoderma virens* using fusion PCR for expression in a bacterial system**

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The hydrolysis of the hemicellulose matrix of lignocellulosic biomass, in order to release the cellulose fibers is a crucial step in second generation bio-ethanol production. Endo-1,4- $\beta$ -xylanase (*exn*) is one of the main components in the hemicellulase enzyme complex. The main objective of this study was to modify the *Trichoderma virens* fungal endoxylanase gene and express it in a bacterial expression system *E. coli* BL21(DE3).

A recombinant genomic clone containing the endoxylanase gene in the vector pGEMT had been previously cloned in our laboratory. The *exn23* gene is 687 bp in size containing two exons and a single intron (114 bp) from 174 to 287 bp. Initially to remove the intron, fusion PCR was carried out as follows: DNA was extracted from the recombinant pGEMT plasmid containing the *exngene*. Both exons were PCR amplified separately using the above clone as a template. The first exon was amplified using forward primer (EXN23FP) and a fusion primer (EXN23FS1) that contained a region complementary to the second exon, whereas the second exon was amplified using the reverse primer (EXN23RP) and a fusion primer (EXN23FS2) that contained a region complementary to the first exon. Subsequently, the amplified exons were used as templates and primers EXN23FP and EXN23RP were used for fusion PCR.

The above PCR fused fragment was subjected to TA cloning. Several recombinant clones were obtained and a clone designated *pEXN23* was sequenced. Analysis revealed *pEXN23* to be 100% similar to the coding region of the *exn23* gene of *Trichoderma virens*, indicating that the fusion PCR has successfully eliminated the intron.

**Keywords:** *Trichoderma virens*, second generation bio ethanol, hemicellulase, endo-1,4- $\beta$ -xylanase , fusion PCR



**904/A/Poster**

**Optimization of Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) based method  
for the detection of the dengue virus and identification of dengue virus serotypes using  
serotype specific polymerase chain reaction**

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Dengue (DEN) is considered as the most significant mosquito borne viral disease in Sri Lanka. It is caused by the dengue virus (DENV) and is transmitted to human beings by biting of an infected female mosquito of *Aedes aegypti*. Early diagnosis of DEN has become a major requirement in clinical diagnosis in order to reduce the mortality rate and improve patient management. Therefore, the aim of this study was to optimize a low cost reverse transcriptase polymerase chain reaction (RT-PCR) based method for detection of DENV by selecting a low cost RNA extraction method and also to optimize a serotype specific PCR to differentiate serotypes of DENV.

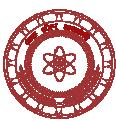
Serum samples ( $n = 20$ ) were collected from DEN confirmed cases from Government Hospitals, checked for the presence of NS1 protein and stored at  $-80^{\circ}\text{C}$  until extraction. RNA was isolated using the different RNA extraction methods from all DEN confirmed serum samples, which included Trizol, Silica and CEYGEN Virospin R™. The best RNA isolation method was identified for the extraction of DENV. Complementary DNA (cDNA) synthesis was optimized using the most successful RNA extraction method. Further, the RT-PCR and nested PCR were optimized using cDNA.

The RNA isolation showed successful results with commercially available low cost RNA extraction kit (CEYGEN). The RT-PCR amplification conditions were optimized as denaturation at  $94^{\circ}\text{C}$  for 5 min, followed by 40 cycles at  $94^{\circ}\text{C}$  for 15 sec,  $55^{\circ}\text{C}$  for 15 sec,  $72^{\circ}\text{C}$  for 30 sec, and the final extension was carried out at  $72^{\circ}\text{C}$  for 10 min. The serotype specific PCR was successfully optimized with proper amplification conditions. Different annealing temperatures were used such as  $50^{\circ}\text{C}$ ,  $42^{\circ}\text{C}$  and  $50^{\circ}\text{C}$  for different DENV serotypes D1, D2, D3 and D4, respectively. Overall, three samples were confirmed as positive for DENV. The D1, D2 and D4 DENV serotypes were identified with band sizes of 490, 230 and 398 base pairs respectively. Therefore, in this study, RT-PCR and serotype specific PCR methods were successfully optimized to diagnose DENV as well as serotypes of DENV and with further evaluations this method could be used in diagnosis of DENV.

**Keywords:** RNA extraction, cDNA synthesis, Reverse Transcriptase Polymerase Chain Reaction; nested Polymerase Chain Reaction.

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**905/A/Poster**

**Comparison of parasitological and molecular diagnostic methods used for malaria diagnosis  
in the phase of prevention of reintroduction of malaria in Sri Lanka**

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With no indigenous cases of malaria being reported since October 2012, Sri Lanka is now in the prevention of reintroduction phase. We were able to complete 3 consecutive years without local transmission and became eligible for the WHO certification as a malaria-free country. To prevent reintroduction, intensified surveillance becomes the most critical strategy. Each case of malaria needs to be laboratory confirmed which is done by microscopy and rapid diagnostic tests (RDTs). Since microscopy is highly operator-dependent and validity of RDTs also may vary under different field conditions, evaluation of these diagnostic methods becomes very important. This study was carried out to evaluate the two parasitological diagnostic methods using nested PCR.

Blood samples were collected from 186 patients with suspected malaria and 100 high risk asymptomatic individuals. Microscopy, Combo RDT (CareStart™ Malaria HRP2/pLDH {Pf/PAN} which detect pLDH common to genus *Plasmodium* and HRP2 antigen which is present only in *Plasmodium falciparum*) and nested PCR were performed on all samples. Diagnostic indices were calculated considering the nested PCR as the reference. Sensitivity of both microscopy and RDT were 95.35% (95% CI: 88.52-98.72), while specificity of microscopy and RDT were 99 % (95% CI :94.55-99.97) and 94% (95% CI :87.40-97.77), respectively. The positive and negative predictive values of microscopy were 98.80% (95% CI :93.47-99.97) and 96.12% (95% CI :90.35-98.93) while, corresponding values for RDT were 93.18% (95% CI :85.75-97.46) and 95.92 % (95% CI :89.88-98.88), respectively. Among the 100 high risk individuals screened, none were positive by microscopy, RDT or PCR. This study indicates that the parasitological diagnosis methods used in this study are highly sensitive and specific.

**Keywords:** Malaria, rapid diagnostic tests, microscopy, nested PCR

**Acknowledgement:** Financial assistance from the National Science Foundation grant no. RG/2014/HS/03.



**906/A/Poster**

**A study on patient information, treatment side effects and patient satisfaction of radioiodine treated patients**

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Radio Active Iodine (RAI) therapy is given to patients with thyroid malignancy and hyperthyroidism. Study objectives were to obtain patient information, psychosocial informational support received, side effects of RAI therapy and patient satisfaction on RAI therapy at the Nuclear Medicine Unit (NMU), Karapitiya.

In this study, only outpatients were considered. A prospective cross sectional study was conducted among all the patients ( $n = 147$ ) who received a therapeutic dose of  $^{131}\text{I}$  from the NMU, Karapitiya. A self-administered questionnaire was used to gather data.

The response rate was 68%. Thyroid diseases were more common among females. The probability of occurrence of a thyroid disease increased with age. Rapid heart rate and palpitations, moist skin and increased perspiration were the most common symptoms reported. Thyroid nodules were frequent among female patients. Bulging eyes was more frequent among male patients. As the method of diagnosis, 93% of the patients had undergone blood tests. Patients were offered additional support at the stage of diagnosis at a satisfactory level. RAI therapy protocols had provided clear information about the stage of diagnosis. A few number of patients sought psychological support. None of the male respondents had more than one RAI treatment, whereas female respondents had undergone treatment twice or thrice. Dry mouth, taste disturbance, sore neck and skin problems were most frequent side effects of RAI therapy and some female patients had changes in their menstrual cycle. 22% had declared that they did not suffer from any side effects. 64% of the RAI treated patients returned to their normal range of activities in less than a month. 53.1% of the respondents had stopped taking any medications after RAI therapy. Symptoms related to thyroid disease did not significantly reappear after RAI therapy ( $p = 0.011$ ). Additional support at the stage of diagnosis, returning to normal range of activities and discontinuing medication indicates outpatient RAI therapy had increased patient satisfaction at Karapitiya NM unit. Hence patients can expect a positive outcome of the disease free status after RAI therapy.

**Keywords:** patient information, thyroid disease, Radio Active Iodine



**907/B/Poster**

**Evaluation on the performance of photo period insensitive winged bean (*Psophocarpus tetragonolobus* (L.) DC.) varieties in the mid-country wet-zone of Sri Lanka**

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Vegetable production in Sri Lanka needs to be improved to fill the gap between the per capita requirement and the availability. Introducing improved varieties and improving crop management practices are the most practicable methods to increase the production. Winged bean is a promising leguminous vegetable, which can be cultivated throughout this country. The objective of this study was to identify adaptable, high yielding photoperiod insensitive, pest and disease tolerant/resistant varieties of winged bean. This research was conducted at the research fields of the Horticultural Crop Research and Development Institute (HORDI), Gannoruwa, Peradeniya, (mid country wet zone). Seven varieties were tested for ten successive seasons from Yala 1999, namely, Chinese, Chinese(M), UPS-139, UPS-122(Krishna), SU-413, SLS-44 and Dwarf, in a Randomized Complete Block Design (RCBD), with 4 replicates. UPS - 122 (Krishna) recorded the highest mean yield of 17.7 t/ha, while SLS44 gave the lowest yield of 13.5 t/ha. The yield was significantly different among the varieties tested ( $P=0.0016$ ). The breeding method was selection and purification. Cultural and agronomic practices were performed according to the Department of Agriculture recommendations. Both qualitative and quantitative data showed that the two varieties UPS-122 (Krishna) and SLS-44 performed well, with regard to mean no of days to first flowering, mean no of days to 50% flowering, mean no of days to first pick, mean no of days to last pick, marketable fresh pod yield (t/ha), mean no of picks, mean no of pods per plant, mean single pod weight (g), mean pod length (cm), mean no of seeds per pod, mean circumference at mid - point of the pod (cm), mean 100 seed weight (g). These two varieties were officially recommended and released by the Variety Release Committee (V.R.C.) of the Sri Lanka Government Department of Agriculture. The seeds of the above two varieties were given to the Seed Certification Service (S.C.S) of the Department Of Agriculture, multiplied at the Department of Agriculture Farms and distributed to the farmers.

**Keywords :** Mid-country wet-zone, winged bean



**908/B/Poster**

**Efficacy of seed pre-sowing treatments in *Bridelia retusa* (L.) A. Juss. for seed germination enhancement**

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Breaking seed dormancy is essential for sexual propagation of some plants. This study investigates seed dormancy breaking methods of *Brideliaretusa* (L.) A. Juss. (Phyllanthaceae) as it exhibits a long dormancy period which hinders the seed germination. Seed germination of *B. retusa* was tested in moist cotton wool layered petri dishes (five replicates for each treatment containing 30 seeds) and sterilized soil medium on seed trays (50 replicates for each treatment containing 200 seeds) with pre-sowing treatments [cool water (T1), gibberallic acid (GA<sub>3</sub>) (T2), *Phyllanthus emblica* pulp (T3), synthetic ethylene (T4), ethylene of botanical origin (T5), concentrated sulphuric acid (T6), KNO<sub>3</sub> (T7) and un-treated control (T8)]. The experiment was laid in a completely randomized block design. Germination of seeds and seedling characteristics were recorded daily after seed sowing. Results were analyzed by MINITAB 14. Control seeds were not germinated throughout the study period in both media. The percentage of seed germination in soil medium ( $28.93 \pm 4.17$ ) was significantly higher than that of wet cotton wool in petri dish ( $17.74 \pm 3.00$ ). Seedling type were identified as "Macaranga type" as during germination seedling became free from all envelopments, thin, leaf-like paracotyledons well developed and pure assimilating function. Only the germination tube was arisen in wet cotton wool medium but when transferred to the soil medium further growth was observed and proved that seeds were Macaranga type as they lacked stored food. The percentage of germination seeds was higher in cool water treatment (T1) after the 1<sup>st</sup> week. The percentage of germination increased with time in all treatments. Five weeks after sowing, the highest percentage of seed germination was detected in GA<sub>3</sub>(T2) ( $81.97 \pm 0.83$ ) that was not significantly different with seeds in cool water (T1) ( $61.4 \pm 0.95$ ), *Phyllanthus emblica* pulp (T3) ( $79.0 \pm 1.15$ ) and ethylene of botanical origin (T5) treatments ( $42.53 \pm 0.72$ ). Therefore this study identified that cool water (T1), gibberallic acid (GA<sub>3</sub>) (T2), and *Phyllanthus emblica* fruit pulp (T3) are appropriate methods to enhance seed germination of *B. retusa*. Hence these pre-treatments can be used in future forestry programs to overcome dormancy of *B. retusa*.

**Keywords:** *Bridelia*, germination, pre-treatment, seed dormancy



**909/B/Poster**

**Phenolic and flavonoid contents and antioxidant capacity of green tea incorporated ice cream**

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World famous best quality green tea is made by unfermented leaves of *Camelia senensis*(L) Var. *Chinensis*. Green tea has become widespread globally due to its valuable health benefits. Most of the health benefits are due to the availability of polyphenols in green tea. This study was conducted to determine total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC) of green tea incorporated ice cream and to determine the content of green tea to be added into the ice cream with best flavor, nutritional and medicinal values.

Almost all the commercially-grown tea cultivars in Sri Lanka originate from var. *Assamica*. Good quality green tea powder cannot be produced from var. *Assemeica* due to its higher astringent compounds. According to the results of a sensory evaluation, green tea powder with low astringent compounds, manufactured from tea flushes (two leaves+bud) of var. *Assemeica* TRI 4047 grown under shade with freeze drying technique was used as the ingredient to produce green tea ice cream. Consumer preference for green tea ice cream which was prepared with different amounts of green tea powder (5, 10, 15 and 20 g) was determined by the hedonic test. TAC of green tea ice cream was determined by ferric reducing antioxidant power (FRAP) assay. Colorimetric methods were used to determine TPC (Folin-Ciocalteu) and TFC in green tea ice cream.

The results revealed that, in terms of colour and flavor, 15 g (500 mL of fresh milk, 125 mL of whipping cream, 150 g of sugar and 3 egg yolks) was the most suitable amount for producing green tea ice cream. Significantly higher TAC ( $757.9 \pm 11.0$  mg TE/100 g FW), TPC ( $324.3 \pm 13.8$  mg GAE/100 g FW) and TFC ( $3.1 \pm 0.02$  mg RE/ 100 g FW) were observed in green tea incorporated ice cream (with 15 g green tea powder) when compared to normal ice cream (without green tea powder). TAC, TPC and TFC values increased with increased concentrations of green tea powder in the ice cream. The results suggested that green tea ice cream could be considered as a value added healthy food.

**Keywords:** Antioxidant capacity, consumer preference, flavonoids, green tea ice cream, phenolics



**910/B/Poster**

**Phenolic and flavonoid contents and antioxidant capacity of selected underutilized fruit species in Sri Lanka**

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The aim of this study was to determine total antioxidant capacity (TAC), total phenolic content (TPC) and total flavonoid content (TFC) of six underutilized fruit species namely; *Naminan* (*Cynometra cauliflora*), *Lawulu* (*Pouteria campechiana*), *Jambu* (*Syzygium aqueum*), *Ambilla* (*Morus australis*), *Billin* (*Averrhoa bilimbi*) and *Veralu* (*Elaeocarpus serratus*) grown in Sri Lanka. Well ripened fruits of each species were harvested from home gardens and directly transported to the laboratory under cool condition. A completely randomized design (CRD), with three randomly selected sample replicates was used in the experiment. Ferric reducing antioxidant power (FRAP) assay was used to evaluate TAC, whereas the TPC was determined by Folin-ciocalteu method and TFC was evaluated by a colorimetric method. *Lawulu* had significantly the highest TAC ( $10.17 \pm 0.47$  mg TE/g FW) and TPC ( $7.58 \pm 0.25$  mg GAE/g FW) whereas significantly highest TFC ( $17.37 \pm 0.28$  mg RE/g FW) was observed in *Naminan* fruit. Significantly lowest TAC ( $0.49 \pm 0.01$  mg TE/g FW) and TFC ( $0.17 \pm 0.04$  mg RE/g FW) were recorded in *Billin*, while *Jambu* recorded the lowest phenolic content ( $0.37 \pm 0.02$  mg GAE/g FW). No flavonoids were detected in *Jambu*. In selected underutilized fruit species, TAC showed positive significant correlations with the total phenolics ( $R^2 = 0.98$ ,  $p < 0.001$ ) and total flavonoid content ( $R^2 = 0.66$ ,  $p < 0.001$ ).

The results revealed that among selected underutilized fruits, *Lawulu* and *Naminan* fruits had higher TAC and TPC whereas very low levels of phenolic compounds and antioxidant capacity were recorded in *Billin* and *Jambu* fruits. Therefore, *Lawulu* and *Naminan* are suggested as good dietary antioxidant sources. The significant positive correlations between TAC and phenolic compounds indicated that phenolic components contributed significantly to the fruit antioxidant capacity.

**Keywords:** Antioxidant capacity, flavonoids, phenolics, underutilized fruits



**911/B/Poster**

**Effect of potting media on germination and growth performance of seedlings of *Pterocarpus marsupium* (Gammalu)**

N M K K Nawarathna<sup>1\*</sup> and H M N M Watagodakumbura<sup>2</sup>

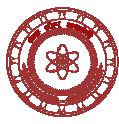
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<sup>2</sup>Hardy Advanced Technological Institute, Prof. Evan A. Hardy Mawatha, Ampara

*Pterocarpus marsupium* belonging to family *Leguminosae* is naturally grown in lowcountry and upcountry in the “Pathana” areas in Sri Lanka. It is mainly found in the Monaragala District up to an elevation of 3000 feet and is a valuable medicinal plant. There are other *Pterocarpus* species found in the world having medicinal value and *P. podocarpus*, *P. officinalis*, *P. santalinus* and *P. indicus* are some of them. Poor germination and growth performance of the seedlings of *P. marsupium* are the main obstacles in the propagation of this plant.

An experiment was conducted to evaluate the performances of seed germination and seedling growth of *P. marsupium* in different potting media. The potting media used in the experiment were mixtures of different ratios of sand (S), soil (SO), cattle manure (C), poultry manure (P), and vermi compost (V). The ratios of the potting mixtures were S+SO+V (T1) 1:1:1 (T2) 1:2:1 (T3) 1:1:2 (T4) 2:1:1, S+SO+C (T5) 1:1:1 (T6) 1:2:1 (T7) 1:1:2 (T8) 2:1:1, S+SO+P (T9) 1:1:1 (T10) 1:2:1 (T11) 1:1:2 (T12) 2:1:1, (S+SO)+V+C (T13) 1:1:1 (T14) 1:2:1 (T15) 1:1:2 (T16) 2:1:1, (S+SO)+V+C (T17) 1:1:1 (T18) 1:2:1 (T19) 1:1:2 (T20) 2:1:1, (S+SO)+C+P (T21) 1:1:1 (T22) 1:2:1 (T23) 1:1:2 (T24) 2:1:1 and (S+SO)+(C+P)+V (T25) 1:1:1 (T26) 1:2:1 (T27) 1:1:2 (T28) 2:1:1.

The design of the experiment was RCBD with 03 replicates. The rate of emergence, germination index and survival percentages were the indicators estimated to evaluate the germination and growth performances of seedlings. The effect of treatments was significant at  $\alpha = .05$  in Chi Square test. Sand+Soil+Cattle Manure (1:1:2) mixture had a germination Index of 7.6, survival percentage of 96% and rate of emergence of 49.85%. Sand+Soil+Cattle manure (1:1:2) mixture was highly significant than other treatments in relation to germination index, rate of emergence and in survival percentage in the least significant difference (LSD) test. Among the potting mixtures tested, the potting mixture containing Sand+Soil+Cattlemanure (1:1:2) was found to be the most suitable potting mixture which enhanced the germination and seedling growth of *Pterocarpus marsupium*.



913/B/Poster

**Chemical composition of starches isolated from wheat, rice, foxtail millet, proso millet, cassava and sweet potato**

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Starch is used in the food industry to impart functional properties, and to modify food texture and consistency. Both the amount of starch and its type are greatly critical for the texture of a given product. The chemical properties of starch differ with its source. In recent years, substantial efforts were made to obtain starches from non-conventional sources and to study their physicochemical properties. In this study, wheat flour (*Triticum spp.*), rice (*Oryza sativa*; Bg 357), foxtail millet (*Setaria italic*; ISC 480), proso millet (*Panicum miliaceum*; AC 254), cassava (*Manihot esculenta*; Kirikawadi) and sweet potato (*Ipomoea batatas*; Wariyapola-red) starches were obtained according to the alkali extraction method. Moisture contents, crude protein, crude fat, crude fiber and ash content were determined and compared. The yield of starch of wheat, rice, foxtail millet, proso millet, cassava and sweet potato were 54.43%, 64.10%, 27.83%52.83%, 54.47% and 40.77%, respectively, on dry weight basis with a high level of purity (>99). This investigation showed that the isolated starches contained 0.43-0.71% crude protein, 0.10-0.14% crude fat, 0.12-0.16% crude fiber, 0.25-0.47% ash and 99.03-99.29% of carbohydrate on dry weight basis. Moisture content of starches ranged from 10.35 to 13.30%. Among the starch sources, rice yielded the highest starch content while foxtail millet contained the lowest starch content. Among the two yams, cassava contained more starch than sweet potato. Compared to root starches, cereal starches contained a higher level of lipid and protein, while root starches contained higher level of moisture and fiber. The study would be useful to better understand the chemical composition of selected starches.

**Keywords:** Foxtail millet, proso millet, proximate composition, starch isolation



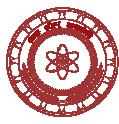
914/B/Poster

### Analysis of phenolic, flavonoid and anthocyanin content in edible flowers

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Phenolic compounds such as flavonoids and anthocyanin play a major role as antioxidants. Flowers are an important plant part that contain high amount of phenolic antioxidants. People use different flower species for different preparations. In this study, ten edible flower species, *Aponogeton crispus* (Kekatiya), *Lasia spinosa* (Kohila), *Sesbania grandiflora* (Kathurumurunga), *Cassia auriculata* (Ranawara), *Aegle marmelos* (Beli), *Hibiscus rosa-sinensis* (Pokuruwadama), *Allium cepa* cv. group *Cepa* (Onion), *Brassica oleracea* var. *botrytis* (Cauliflower), *Gmelina asiatica* (Demata) and *Azadirachta indica* (Kohomba), were collected, oven dried, ground and phenolics were extracted using 80% methanol. Various *in vitro* assays were conducted on these flower extracts to determine the total phenolic, total flavonoid and total anthocyanin contents. The total phenolic content ranged from  $5.28 \pm 0.25$  to  $35.66 \pm 1.47$  g of gallic acid (GAE)/kg of fresh material (FM) among selected flower species. The flavonoid content was in the range of  $2.53 \pm 0.50$  to  $25.54 \pm 0.82$  g of quercetin equivalent (QE)/kg of FM. The anthocyanin content was also high in these edible flowers and ranged in between  $3.09 \pm 0.11$ - $101.18 \pm 5.36$  g/kg of FM. *Aegle marmelos* had the highest total phenolic ( $35.66 \pm 1.47$  g of GAE /kg of FM) and flavonoid content ( $25.54 \pm 0.82$  g of QE /kg of FM) while *Hibiscus rosa-sinensis* had the highest anthocyanin content ( $101.18$  g/kg of FM). This study revealed that edible flowers are a good source of phenolics, flavonoids and anthocyanins.



**915/B/Poster**

**Evaluation of the effect of plant material as fermentation inhibitors for palmyrah sap**

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Palmyrah sap is an important output which is used for sweet toddy or fermented toddy production. Due to the high sugar content, sap is easily fermented during collection by air borne wild microbes due to contamination of pots or containers. However, for sweet toddy, treacle and jaggery production, fermentation should be inhibited to maintain the fresh sap until further processing. Lime is commonly used as fermentation inhibitor in sweet toddy production. Although lime acts as a good inhibitor, accumulation of ions, coagulation of protein and time taken to adjust the pH of the sap are problems associated with usage of lime. This study was carried out to evaluate five plant material such as *Launaea coromandelica* dried bark, *Anacardium occidentale* leaves, *Vateria acuminata* bark, *Syzygium cumini* bark and seeds, as fermentation inhibitors of palmyrah sap. Powdered form of 5.0 g plant material was added into each collecting clay pot. The pots were hung over the crown of the tree to collect the sap for 24 hours. Sap collected from lime added clay pot and pots without any additive were taken as positive and negative controls, respectively. Immediately after 24 hours of collection, physicochemical properties of the sap, total soluble solids, pH, acidity and alcohol content were analysed. Based on the results better materials used were screened out. The screened materials were assayed for polyphenolic (total phenol, flavonoid and tannin) content. Based on the results, *L. coromandelica* bark, *S. cumini* bark and *V. acuminata* bark were selected as effective fermentation inhibitors for palmyrah sap due to high total soluble solids, high pH, low acidity and low alcohol content. Colour formation in the sap was observed for *L. coromandelica* bark and *S. cumini* bark. According to the polyphenolic analysis *L. coromandelica* bark showed highest values for total phenol, flavonoids and tannin in the aqueous extract. However, *V. acuminata* bark showed the highest values for total phenol and tannin while *L. coromandelica* bark showed the highest value for tannin content.



916/B/Poster

**Effect of gamma irradiation on physico-chemical and sensory properties of a high energy cereal bar**

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Gamma-irradiation is a preservative technique that has a growing trend of application in the modern food production systems. Sterilization using gamma irradiation causes lethal effects of ionizing radiation on microbial populations through penetrative power of Cobalt-60. The objective of this study was to develop a high energy cereal bar with an extended shelf life using gamma irradiation, to be used as an emergency food targeting security forces and people affected by environmental disasters.

Three formulations of high energy cereal bars were developed using different local ingredients. The best cereal bar formulae was selected based on the proximate composition and high calorific value. Samples were packed in selected commercial grade packaging and subjected to three treatment doses of gamma irradiation at 10 kGy, 20 kGy and 30 kGy. The untreated sample (0 kGy) was considered as the control and its protein, fat, crude fiber, moisture, carbohydrates and energy value were 19.77%, 13.58%, 2.34%, 5.32%, 56.45% and 427.20 kcal, respectively. The sensory properties of treated and untreated energy bars were determined using a 9 point hedonic scale with 12 trained panelists. Gamma irradiation showed significant differences ( $p<0.05$ ) in the sensory properties of taste and odour at 20 kGy and 30 kGy compared to 10 kGy and control. Peroxide value was significantly ( $p<0.05$ ) high at 20 kGy and 30 kGy. Protein content decreased with increasing irradiation dose. Present study indicated that the best irradiation dose to preserve the nutritional and sensory properties of formulated high energy cereal bar was 10 kGy.

**Keywords:** Cereals, energy bar, gamma irradiation, irradiation doses

**Acknowledgement:** Financial assistance by the Treasury research grant - TG 16/124



917/B/Poster

**Impact of light intensity on early vegetative growth of *Pogostemon heyneanus* Benth.  
(Lamiaceae)**

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*Pogostemon heyneanus* Benth. (Lamiaceae) is a large, straggling under shrub cultivated to extract patchouli oil, a high demand ingredient in pharmaceutical, perfumery, food and beverage industries. However, the effect of local external environmental factors on growth of *P. heyneanus* under field conditions has not been studied. Therefore a field experiment was conducted to determine the effect of different light intensities (full sunlight, 50% and 70%) on growth of *P. heyneanus* in terms of plant height, number of leaves, number of branches, branch length, plant spread, stem diameter and total chlorophyll content. The treatments were arranged with randomized complete block design with three replicates. Plant growth data were taken at fortnight intervals for a period of two months. Two months after planting, foliar chlorophyll contents were determined under each shade level. All the data collected were subjected to analysis of variance and the means were separated by Duncan's Multiple Range Test at a probability level of 0.05. During the period of study plant height, number of leaves, number of branches, branch length, plant spread, stem diameter significantly increased with the increase in shade level. For all tested parameters the highest growth was found in plants grown under the shade of 70% while the minimum was found in plants grown under full sunlight. The highest amount of foliar chlorophyll content was found in the plants grown under 70% and it was significantly different from 50% shade and under full sunlight. However, chlorophyll contents were not significantly different between 50% shade and full sunlight. Our results concluded that among the selected shade levels *P. heyneanus* had the highest vegetative growth under the shade of 70%. It could be partially justified that *P. heyneanus* could be successfully cultivated under intensive shaded conditions. However, the current study has to be further continued on herbage yield, oil content, oil composition, secondary metabolites and bioactivity for an extended period of time before recommendations could be suggested.

Keywords: Full sunlight, *Pogostemon heyneanus*, 50% shade, 70% shade



918/B/Poster

**Effect of different drying temperatures on oil yield, total antioxidant capacity and bioactive compounds of *Pogostemon heyneanus* Benth. (Lamiaceae)**

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*Pogostemon heyneanus* is an aromatic crop which has a great demand in patchouli oil extraction for food, beverage, pharmaceutical and perfumery industries. *P. heyneanus* leaves and stems must be dried for removing excess moisture prior to the distillation step. The temperature of drying air influences the quantity and quality of the active ingredients present in the herbage. The study was conducted to find out the effect of different drying temperatures; room temperature, 40, 45, 50, 55 and 60 °C on drying herbage of *P. heyneanus* in terms of drying time, drying curves, oil yield and composition of bio chemical compounds. Initial moisture contents of freshly harvested stems and leaves of *P. heyneanus* were determined using microwave oven method and moisture loss was recorded at three hourly intervals in order to plot drying curves under different drying temperatures. The dried herbages were tested for oil content using Clevenger arm apparatus. The total antioxidant capacity (TAC), total flavonoid content (TFC), and total phenolic content (TPC) of dried herbage were tested, respectively, using Ferric Reducing Antioxidant Power assay (FRAP) method, a colorimetric method and Folin–Ciocalteu method. The data were subjected to analysis of variance and the means were separated by Duncan's Multiple Range Test at a probability level of 0.05. The average initial leaf moisture content of *P. hayneanus* herbage was estimated to be about 356% dry basis (db), and that of the stem was about 372% (db). The total time required to reach the final moisture content of drying leaves to less than 20% (db), under room temperature, 40, 45, 50, 55 and 60°C were approximately 18, 33, 21, 18, 12, 9 hours respectively and that of the stems were 36, 36, 21, 21, 15, and 12 hours respectively. The highest leaf and stem oil contents, 2.5% and 0.51%, were found under 55°C while those of the lowest, 1.95% and 0.35%, were found under room temperature respectively. Since there is no significant difference in oil content extracted at 45, 50 and 55 °C, a temperature of 45 °C is recommended to conserve bioactive compounds and antioxidant capacity.

**Keywords:** *Pogostomen heyneanus*, drying, total antioxidant capacity, total flavonoid content

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919/B/Poster

**Crop water requirement studies of nursery stage plants of *Pogostemon heyneanus* Benth.  
(Lamiaceae) under different irrigation intervals**

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*Pogostemon heyneanus* Benth. (Lamiaceae) is cultivated to extract patchouli oil which is in high demand in the pharmaceutical, perfumery, food and beverage industries. Being a herbaceous plant it is highly sensitive to soil moisture decline resulting poor vegetative growth in nursery and field stages. Proper irrigation interval can play a major role in nurseries as it increases plant water use efficiency and productivity. The experiment was conducted with four distinct treatments of irrigation intervals; three times per day, two times per day, once a day and every other day to evaluate growth, crop coefficients and crop water requirement of nursery stage plants of *P. heneanus*. The complete randomized block design was used with five replicates. All the data collected were subjected to analysis of variance and the means were separated by Duncan's Multiple Range Test at a probability level of 0.05. The plants irrigated three times per day had the maximum growth in terms of plant height, stem diameter, number of leaves, number of branches and branch length and also it recorded the highest weekly average daily crop coefficients. The differences of weekly average daily crop coefficients in-between different irrigation intervals of two times per day, once a day and every other day were gradually reduced with the time and the reduction was not significantly contrast during sixth, seventh and eighth week of the study. The highest crop water requirement (468.73 mm) was found in plants irrigated three times per day followed by irrigation interval of two times per day (361.64 mm), irrigation interval of once a day (340.53mm) and irrigation interval of every other day (313.45 mm), respectively. Among the selected irrigation intervals, the irrigation interval of three times per day where the maximum water use was found had the best growth of plants of *P. heyneanus* during its nursery stage. In terms of cost of irrigation, practicing irrigation every other day for nurseries of *P. heyneanus* could be partially justified as the next best alternative. However, the study has to be continued further on different irrigation intervals above three times per day and below every other day before recommendations are made.

**Keywords:** *Pogostemon heyneanus*, Irrigation interval, crop water requirement, Lamiaceae



920/B/Poster

### Optimization and acceleration of alcohol fermentation process in pineapple peel vinegar production

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Pineapple (*Ananas comosus L.*) is an important economic crop in Sri Lanka and its peel (40-50 % of whole fruit) is usually discarded during its processing. The present study was conducted to optimize and accelerate the alcohol production process of pineapple peel vinegar which usually takes 20 days in the normal process. Optimization of two main steps i.e., preparation of juice using pineapple peel and alcohol fermentation procedures were considered. Efficiency of each step was evaluated by measuring the formed alcohol % and changes of brix value. The collected pineapple peel was washed with water followed by steam blanching for 2 minutes. Peel was blended and juice collected following filtration. Alcohol fermentation was done at 29 °C with baker's yeast. In order to optimize the alcohol fermentation, addition of yeast and sugar amounts were determined. Baker's yeast was added separately at 0.27% and 3% levels to the pineapple peel juice to determine the optimum amount of yeast. Sugar was added to adjust the Brix to 16%, 18% and 22%, respectively, to determine the optimum Brix. Efficiency of adding sugar was determined by adding sugar at a time for 18% and gradual addition of similar sugar content in 3 consecutive days. Blanching of peel before extraction of juice reduced enzyme activation which suppressed the fermentation process. The optimum Brix was identified as 18% ( $p<0.05$ ). There is no significant difference between the two different amount of yeast used ( $p>0.05$ ). The gradual addition of sugar yielded 13.5% of alcohol on the 5<sup>th</sup> day of fermentation ( $p<0.05$ ) which facilitated acetic acid production by 7 days in the latter stage. Adding of sugar at a time can cause stress to yeast and retard the fermentation process. Thus it can be concluded that alcohol fermentation in vinegar production can be optimized with gradual addition of sugar required to adjust the Brix level of 18% with 0.27% of yeast within five days of fermentation at 29 °C.

Keywords: Acceleration, alcohol fermentation, sugars, adjusting brix



**921/B/Poster**

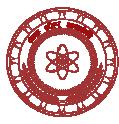
**Extending the post-harvest shelf life of giant guava with thin edible coating**

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Guava (*Psidium guajava* L) is a tropical, climacteric fruit that ripens rapidly and is highly perishable. post-harvest loss of giant guava in Sri Lanka is about 46% and its shelf-life ranges from 3 to 4 days at room temperature (31±2 °C). The aim of the present study was to discover the best treatment to be used to coat the fruits from three treatments, with the combination of tamarind seed powder 0.05% (w/v), sunflower oil 3.5, 4.5, 5.5% (v/v) and 1% (w/v) beeswax. Shortest dipping time 2 seconds (2s) was used to produce thin coating around the fruit with water based mixture. Coated fruits were stored under ambient condition (31±2 °C). Effectiveness and properties of the coating were evaluated for 10 days by examining coating pickup, weight loss percentage, physical appearance, height loss percentage, width loss percentage, pH, titratable acidity, total soluble solids, moisture content and organoleptic changes. Effectiveness of coating in retardation of yeast and mold growth was also proven. There was no significant difference in the thickness of coating that indicated by the coating pickup, among each treatment ( $p<0.05$ ). Results showed that weight loss percentage, height loss percentage, width loss percentage, total soluble solids and moisture content of coated guava significantly differed ( $p<0.05$ ) from uncoated guava with 9 days of storage. The lowest weight loss ( $20.46 \pm 1.38\%$ ),height loss ( $8.25 \pm 2.44\%$ ),width loss ( $9.69 \pm 0.67\%$ ),yeast and mold counts ( $5.97 \pm 0.046 \log \text{CFU/g}$  of peel) and highest consumer preference ( $p<0.05$ ) were obtained for guava treated with tamarind seed powder 0.05% (w/v), sunflower oil 5.5% (v/v) and 1% (w/v) beeswax. Results concluded that post-harvest shelf life of giant guava can be extended up to 9 days by applying thin edible coating of the natural water based emulsion mixture of tamarind seed powder, sunflower oil and beeswax.

**Keywords:** Beeswax, Thin edible coating, Guava (*Psidium guajava* L), sunflower oil, tamarind seed powder



**922/B/Poster**

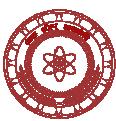
**Evaluation of potential use of *Moringa oleifera* leaf meal as a partial replacement for fish meal in diets for Guppy (*Poecilia reticulata*)**

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*Moringa oleifera* (*Moringa*) is a highly valued plant, distributed in many countries of the tropics and subtropics. Leaves of *M. oleifera* are a rich source of protein and the composition of amino acids in the leaf protein is well balanced. The present study was carried out to evaluate the potential use of *M. oleifera* leaf meal as a partial replacement for fish meal in diets for *Poecilia reticulata* fry. Four experimental diets were formulated by inclusion of *M. oleifera* leaf meal at levels of 0%, 5%, 10% and 15% in CD, 5MD, 10MD and 15MD diets respectively. Twenty one day old male *P. reticulata* (total length  $2.28 \pm 0.01$  cm and body weight  $0.11 \pm 0.00$  g) were randomly distributed into 12 experimental tanks at a stocking density of 10 fish per tank and fed on respective diets three times per day for 8 weeks. The food consumption (% BW/day), average daily gain (% ADG), specific growth rate (% SGR), survival rate, feed conversion ratio (FCR) and Hepatosomatic Index (HSI) of fish were analyzed. At the end of the experiment the results showed that fish fed on four different diets were similar to each other in total length ( $3.02 \pm 0.23$ - $3.16 \pm 0.21$  cm), body weight ( $0.30 \pm 0.08$ - $0.35 \pm 0.07$  g), food consumption ( $9.28 \pm 1.75$ - $10.30 \pm 2.34$ ), % ADG ( $2.21 \pm 1.86$ - $2.43 \pm 1.80$ ), % SGR ( $1.82 \pm 1.41$ - $2.00 \pm 1.29$ ), % Survival ( $91.11 \pm 3.33$ - $91.85 \pm 3.76$ ), FCR ( $1.18 \pm 0.42$ - $1.86 \pm 0.46$ ) and HSI ( $1.79 \pm 0.79$ - $2.38 \pm 0.53$ ). The present study showed that *M. oleifera* leaf meal can be used as a low cost ingredient to partially replace fish meal ingredient diets for *P. reticulata* up to 15% inclusion level without any significant reduction in growth.

**Keywords:** *Moringa oleifera*, *Poecilia reticulata*, protein replacement, growth performance, survival



923/D/Poster

**Proanthocyanidins and selected phenolic and non phenolic compounds in bark and leaf of Ceylon cinnamon (*Cinnamomum zeylanicum* Blume)**

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Ceylon cinnamon (CC) (*Cinnamomum zeylanicum* Blume) is the ‘true cinnamon’ among different species of cinnamon worldwide. Bark of *Cinnamomum* species is reported as one of the richest sources of phenolics especially proanthocyanidins. Further, a wide array of non phenolic compounds (NPC) are also present in the cinnamon bark. Moreover, cinnamon proanthocyanidins and NPC such as cinnamaldehyde are reported to have many health benefits. However, to date proanthocyanidins, phenolic and NPC in bark of CC are not well investigated. Further, there are no such previous reports on leaf of CC. Present study investigated total proanthocyanidins (TPs) and selected phenolic and NPC in bark and leaf of CC.

Freeze dried 95% ethanol and 1:1 dichloromethane:methanol (DCM:M) bark extracts (BEs) and leaf extracts (LEs) of authenticated CC were used in this study. The HCl-butanol assay was used in quantification of TPs (n=6 each). Quantification of selected phenolic (euginol, kaempferol, phorizidin, epicatechin, catechin, 4-hydroxy benzoic acid and gallic; n=3 each) and NPC (cinnamyl acetate, cinnamaldehyde and trans cinnamic acid; n=3 each) were performed using HPLC-DAD method.

Varying quantities of TPs, phenolic and NPC were observed in ethanolic and DCM:M both BEs and LEs. TPs were significantly high ( $p<0.05$ ) in bark [ $1098\pm73$ - $1381\pm46$  mg cyanidin equivalents (CE)/g of extract (GE)] compared to leaf ( $309\pm3$ - $434\pm14$  mg CE/GE) for both extracts studied. Phenolic and NPC tested were significantly ( $p<0.05$ ) high in ethanolic extracts of both bark and leaf compared to DCM:M bark and leaf extracts (except euginol in ethanolic BE and epicatechin in ethanolic LE). Among phenolics tested catechin ( $17.28\pm1.65$  mg/GE) and euginol ( $104.38 \pm 1.79$  mg/GE) were the highest containing phenolic compounds in ethanolic extracts of bark and leaf, respectively, while gallic was the lowest (bark: $2.14 \pm 0.28$  mg/GE; leaf:  $0.81 \pm 0.06$  mg/GE). Similarly, among NPC tested cinnamaldehyde ( $101.91 \pm 3.61$  mg/GE) and cinnamyl acetate ( $44.53 \pm 3.22$  mg/GE) were the highest containing phenolic compounds in ethanolic extracts of bark and leaf respectively whereas lowest was trans cinnamic acid (bark: $3.33 \pm 0.65$  mg/GE; leaf:  $7.68 \pm 0.55$  mg/GE). It is concluded that CC bark had high TPs compared to leaf. The phenolic and NPC tested had varying quantities in both bark and leaf.

**Keywords:** Ceylon cinnamon, total proanthocyanidins, phenolic and NPC, bark and leaf.



924/D//Poster

**Breeding preference of *Aedes aegypti* Linnaeus and *Aedes albopictus* Skuse in the Kandy District**

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Dengue and dengue hemorrhagic fever are major public health problems in Sri Lanka. Kandy District is one of the highly affected districts in the country by dengue. As source reduction is the most cost effective method of dengue vector control, knowledge on breeding preference of dengue vectors, *Ae. aegypti* and *Ae. albopictus* is very important in application of appropriate vector control interventions. In this study, 15 Medical Officer Health (MOH) areas in the Kandy District, namely, MOH Akurana, Bambaradeniya, Galagedara, Gampola, Gangawatakorale, Warallagama, Mahanuwara Municipal Council, Kundasale, Manikhinna, Nawalapitiya, Waththegama, Thalathuoya, Poojapitiya, Udunuwara and Yatinuwara were selected for dengue vector surveillance. Entomological surveillance was conducted in each MOH area on a monthly basis for a period of 12 months from January to December 2015 by trained entomological teams attached to the Regional Office of the Anti Malaria Campaign and MOH Offices. In each survey, 100 randomly selected houses in dengue case reported localities in each MOH were surveyed using dipping and pipetting methods. *Aedes* breeding places were recorded, species identified and the Container Index (CI) calculated for *Ae. aegypti* and *Ae. albopictus* for each breeding place. The study revealed 25 different types of breeding sites in the areas (n=25,679) throughout the surveillance. The major water holding containers with water were water collecting barrels (22%, n=5585) followed by discarded items (19%, n=4864), water collecting cemented tanks (18%, n=4677), refrigerator trays (16%, n=4017) respectively. There were 383 active breeding sites for *Ae. aegypti* of which discarded items (CI-0.97-0.21, n=111) was the highest, followed by water collecting cemented tanks (CI-0.88-0, n=89), water collecting barrels (CI-0.86-0, n=74), refrigerator trays (CI-0.31-0, n=26) and tyres (CI-0.41-0, n=25) respectively. Main breeding sites of *Ae. albopictus* were discarded items (CI-2.85-0.64, n=413), barrels (CI-1.72-0.42, n=241), refrigerator treys (CI-1.46-0.35, n=216), water collecting cemented tanks (CI-1.33-0.41, n=192) and tyres (CI-1.04-0.30, n=147), respectively. The results indicated that discarded items, water storage containers and refrigerator trays are the preferred breeding places of dengue vectors. Thus, providing a continuous water supply, establishing proper waste management systems and conducting appropriate awareness programmes to encourage source reduction by the community would greatly help to reduce the dengue vector breeding places, vector densities and thereby the dengue incidence in the Kandy District.

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**925/D/Poster**

**Some biological aspects of Frigate tuna (*Auxis thazard*) landed in the Southern, Western and Northwestern coasts of Sri Lanka**

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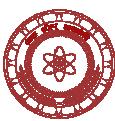
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Frigate tuna (*Auxis thazard*) is an important neritic tuna species found in Sri Lankan waters. Neritic tuna constitutes 14% of the total tuna production of Sri Lanka and frigate tuna contributes almost 42% to this total neritic tuna catches. The gear types used in the neritic tuna fishery in Sri Lanka are gillnets, ring nets and troll lines, with the gillnet being the major gear type. Frigate tuna is a commercially important species as it is favoured by the local community. In addition, due to its abundance, frigate tuna are a major prey item of the larger tunas such as yellowfin tuna and skipjack tuna. Therefore, studying the biology and the reproductive characteristics of this species is very important for the management and sustainable utilization of this species. For this study, Frigate tuna samples were collected from the fishery landing sites in Chilaw (Northwestern), Negombo (Western), Beruwela and Weligama (Southern). A total of 81 samples were collected from October 2015 to May 2016 from day-boats. The weights of the sampled fish ranged from 156 g to 1,353 g and the length varied from 23.8 cm to 42.7 cm. The most common size range of the fish sampled was 29.1 to 33.0 cm. The length weight relationship showed an allometric growth for the species. The analysis of their stomachs revealed that of the 81 stomachs, 51 (62.9%) were empty, 17 (17.3%) were one fourth full, 8 (9.9%) were half full, 5 (6.2%) were three fourths full and 3 (4%) were full. Of the stomachs which contained food, 50% contained digested fish parts (belonging to families Clupeidae and Engraulidae), 44% contained shrimp and 6% contained digested cephalopod parts. Six of the stomachs analyzed contained small nematodes with the digested food items. The Gonado Somatic Index (GSI) for the female fish showed a peak in the month of May. The study will be continued to establish the exact spawning season for the species *Auxis thazard*.

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926/E2/Poster

**Effect of addition of EDTA on calcium absorption by mung plants (*Vigna radiata*)**

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Soil is capable of supporting plant life by supplying various factors including water and nutrients. Soil contains various mineral species such as H<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup>, Na<sup>+</sup>, Fe<sup>2+</sup>, Mn<sup>2+</sup> that adhere to the soil particles and most are present as free ions in the aqueous portion of soil. Calcium is a unique and essential macronutrient for plants. It is required for physiological and biochemical processes and is a defensive agent as well. Insufficient calcium leads to deterioration of the cell membrane. Hence calcium is an important structural component of plants. It acts as a secondary messenger and regulates functions inside the plant cells. Availability of Ca<sup>2+</sup> for plants is reduced due to the formation of stable, insoluble complexes with PO<sub>4</sub><sup>3-</sup> or other ions present in soil. Chelation of Ca<sup>2+</sup> with EDTA to form the Ca-EDTA complex increases its solubility and mobility, thus increasing the availability for crops. It is a currently used technique in large scale agricultural fields. However an in-depth study of the effect of addition of excess EDTA has not been reported.

An EDTA concentration series with the combination of several Ca<sup>2+</sup> concentrations were used for the study to investigate the effect caused by EDTA on calcium absorption, using pot experiments with mung bean (*Vigna radiata*) as the experimental plant. Planted soil after 10, 20 and 30 days of plantation was tested for conductivity, water soluble and exchangeable Ca<sup>2+</sup> in soil.

The maximum tolerable EDTA concentration for the selected mung plants was 1.00 mmol/kg and tolerable Ca<sup>2+</sup> concentration was less than 0.025 mol/kg, under experimental conditions. Higher soil conductivity was shown for the 0.50, 0.75 and 1.00 mmol/kg EDTA concentrations with the combination of 12.50 and 18.75 mmol/kg Ca<sup>2+</sup>. The highest value was recorded for the 1.00 mmol/kg EDTA- 18.75 mmol/kg Ca<sup>2+</sup> combination. The increased water solubility of Ca<sup>2+</sup> was recorded with the increased EDTA concentrations and the maximum value was shown in the 1.00 mmol/kg EDTA- 18.75 mmol/kg Ca<sup>2+</sup> combination. Similarly the maximum exchangeable Ca<sup>2+</sup> was also found in the same combination. A higher deposition of Ca<sup>2+</sup> was found in plant shoots than in roots and the maximum absorption was shown in 1.00 mmol/kg EDTA, with each Ca<sup>2+</sup> series. The overall results showed higher availability of Ca<sup>2+</sup> in soil due to the addition of EDTA. However, the addition of excess EDTA can reduce the available Ca<sup>2+</sup> under field conditions due to leaching. Increased EDTA concentrations increased the availability of the Ca<sup>2+</sup> but very high levels were toxic.

**Keywords:** Calcium, chelation, EDTA, mung plants



927/E2/Poster

**Impacts of gamma irradiation on microbial and chemical quality of Tilapia (*Oreochromis sp.*) fish fillets**

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The study was carried out to evaluate the impact of gamma irradiation on the microbial and chemical quality of tilapia (*Oreochromis sp.*) fish fillets. Fish samples were collected from the Mahakanadarawa tank in the Anuradhapura District, degutted and filleted. The samples were irradiated at 5 kGy, 7 kGy and 10 kGy by a Co-60 gamma source. Influences of the irradiation on total plate count (TPC; n=5), free fatty acid value (FFA; n=2) and peroxide value (n=2) were investigated with respect to non-irradiated (control) samples. TPC showed that bacterial growth in fish fillets were greatly affected by irradiation. The bacterial load of control sample was the maximum ( $3.611 \times 10^5$  cfu/g) followed by 5 kGy irradiated fish fillets ( $1.266 \times 10^3$  cfu/g). The 7 and 10 kGy irradiated samples showed sterilized conditions that resulted in very low bacterial growth. All irradiated samples showed significant reduction of bacterial load with respect to non-irradiated samples. Non-irradiated samples showed the lowest peroxide value ( $42.44 \pm 2.83$  m.eq/1000g) while irradiated samples showed higher values. Seven and 10 kGy irradiated samples showed significant increment of peroxide value with the control samples. Peroxide values of 5 kGy irradiated samples were not significantly different from the control samples, however were significantly increased in the 7 and 10 kGy irradiated samples. Non-irradiated samples showed  $8.58 \pm 0.54$  % FFA while 5, 7 and 10 kGy samples showed  $4.31 \pm 0.73$  %,  $11.86 \pm 0.14$  % and  $1.41 \pm 0.12$  %, respectively. Seven kGy irradiated samples showed the highest FFA value while 10 kGy irradiated samples showed the lowest. The microbiological results indicated that tilapia fillets can be preserved with gamma irradiation with no significant chemical effect.

**Keywords:** Gamma irradiation, tilapia, FFA, TPC, peroxide value

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928/E2/Poster

**Effect of blanching and acidification as a pretreatment to minimize surface white discolouration of sliced carrots in pickles**

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Pickled carrots which are dipped in a hygroscopic solution inside PET (Polyethylene terephthalate) pouches are susceptible to colour deterioration during storage. White appearance is considered as a result of either surface dehydration of outer layers or enzymatic activity or the formation of lignin as a response to wounding. Although heat treatment such as hot water blanching can minimize this defect they can lead to loss of sensory properties and nutritional properties in delicate pickled products which are fermented in a salty environment. Therefore an acidic environment can be provided along with the thermal treatment in order to reduce the temperature required for enzyme inactivation.

A study was carried out to determine the optimum blanching conditions which can maximize the retention of original colour of fresh carrots in the final pickled product. These blanching treatments were at 70 °C to 90 °C for 1 minute and 3 minutes and blanching mediums selected were 2% citric acid and water. At the end of three months of storage period at room temperature, lowest whiteness index and highest chroma value was obtained with the sample blanched at 70°C for 1 minute in 2% citric acid. The loss of bright orange colour due to carotene oxidation intensified the colour deterioration in pickled carrots. Decrease in β carotene content in carrots strongly correlated ( $R^2=0.9918$ ) with decreasing chroma values. However blanching treatments carried out in an acidic environment yielded products with undesirable textural properties except for samples blanched at 70°C for 1 minute. Based on texture properties and colour properties samples treated at 70 °C for 1 minute in both acidic medium and in water and 90 °C for 1 minute in water and also the control sample were selected for further analysis. Antioxidant properties were affected by the thermal treatment and of the four treatments, the highest vitamin C content was reported with the unblanched sample; of the three blanching conditions selected maximum vitamin C content was retained in the sample blanched at 70°C for 1 minute in water and highest Ferric reducing antioxidant power and total phenolic content were obtained with the sample blanched at 70°C for 1 minute in citric acid. Therefore blanching at 70°C in 2% citric acid for 1 minute is the most effective treatment condition which can prevent the enzymatic lignification and carotene degradation while retaining the antioxidant and sensory properties of pickled carrots.



929/E2/Poster

**Effect of the nutritional composition on the textural quality of two gherkins  
(*Cucumis sativus L.*) varieties (Ajax & Vlasset) on brine fermentation**

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Gherkin (*Cucumis sativus L.*) is an important cucurbitaceous vegetable. The pickling type gherkins are produced in Sri Lanka since 1988 for the export market and production has expanded over several agrological regions. Considering the scarcity of scientific information on local gherkin varieties, including their nutritional composition, this study was undertaken to quantify the proximate and mineral compositions. Two locally grown gherkin varieties (Ajax and Vlasset) were tested for proximate composition (moisture, dry matter, ash, mineral, protein, fat, dietary fibre and carbohydrate) of raw fruits (AOAC methods). Also, with 6 month of brine fermentation, firmness measurements (FTA) of the two varieties were recorded and evaluated.

Vlasset and Ajax varieties contained 96.30% and 95.54% moisture, respectively. The ash, protein and fat were higher ( $p<0.05$ ) and dietary fibre, carbohydrate lower in Ajax. Mg, K and Zn content were higher ( $p<0.05$ ) in Ajax with values of  $16.60 \pm 1.47$ ,  $194.0 \pm 7.80$  and  $14.69 \pm 0.40$  ppm, respectively, while the Vlasset variety had lower values. Ca ( $10.62 \pm 0.59$  ppm) and Na ( $13.46 \pm 0.43$  ppm) were greater in Vlasset than in Ajax. Both varieties showed K to be highest followed by Zn, Na and Ca while Mg amount was secondly highest in Ajax and lowest in Vlasset.

Firmness variation of both exocarp and mesocarp of Vlasset showed a similar pattern while giving maximum reading in the 2<sup>nd</sup> month after fermentation. Firmness variation of exocarp and mesocarp of Ajax was different while maximum value was recorded in the 5<sup>th</sup> and 2<sup>nd</sup> months, respectively.

Even though the initial moisture content was higher in Vlasset than in Ajax variety the better textural quality was apparent in Vlasset supported by physicochemical properties such as high dietary fibre, carbohydrate, minerals (Ca, Na) and a higher firmness in mesocarp tissue than exocarp.

Keywords: Gherkin, Ajax, Vlasset, brine fermentation

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930/E2/Poster

**Evaluation of the inhibitory effect on advanced glycation end product formation by an ayurvedic decoction *in vitro***

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Despite the advances observed in modern medicine in recent times, plants still make an important contribution to healthcare. Recent studies have highlighted the importance of herbal medicines with anti-glycation properties. A non-enzymatic process recognized as protein glycation which leads to the irreversible formation of stable compounds known as advanced glycation end products (AGEs) is a major cause of serious chronic diabetic complications such as retinopathy, nephropathy and cardiovascular diseases. It is documented that inhibiting AGE formation could prevent these diabetic complications. The objective of this study was to analyze protein glycation inhibitory potential of a popularly prescribed ayurvedic decoction (AD) which is claimed to have anti-diabetic activity. AD comprised of, *Terminalia chebula*, *Terminalia bellirica*, *Phyllanthus emblica*, *Curcuma longa*, *Coscinium fenestratum*, *Cissampelos pareira*, *Strychnos potatorum*, *Cassia auriculata*, *Cyperus rotundus*, *Syzygium cumini* and *Rubia cordifolia*.

The inhibitory effect of AD on fructose mediated non enzymatic glycation was investigated according to a published method. The reaction mixtures made in phosphatebufferedsaline (0.2M, pH 7.4) contained fructose ( $36 \text{ mg cm}^{-3}$ ), Bovine Serum Albumin (BSA) ( $5 \text{ mg cm}^{-3}$ ) and sodium azide (0.02% to minimize microbial activity). Different concentrations of AD were present in the mixtures. The formation of fluorescent AGEs was measured by using a spectrofluorometer, at an excitation and emission wavelengths of 355 and 440 nm, respectively. Each mixture (in triplicate) was measured after 1 week of mixing. The inhibitory action on glycation by AD was determined.

Aminoguanidine (AG) was used as the positive control. The percentage inhibitions observed after one week of incubation of AD (0.5, 1.0, 5.0, 11.1, 22.2, 33.3  $\text{mg cm}^{-3}$ ) solution mixtures were  $75\pm1.2\%$ ,  $84\pm0.6\%$ ,  $92\pm1.0\%$ ,  $84\pm3.0\%$ ,  $90\pm1.0\%$ ,  $96\pm1.0\%$ , respectively. AG (0.5 1.0, 5.0  $\text{mg cm}^{-3}$ ) gave inhibitions of  $65\pm3.5\%$ ,  $68\pm0.57\%$  and  $98\pm1.0\%$  respectively. These results showed that in comparison to Aminoguanidine, the ayurvedic decoction (AD) had a marked inhibitory potential towards AGEs formation.

931/E2/Poster

**Sitosterol palmitate can bind to human glucocorticoid receptor as an agonist:  
an *in silico* study**

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The “Sri Lankan Flora” is an online database of force field parameters and several structural parameters of compounds that can be used in molecular modeling. The database contains nearly 200 compounds isolated and identified from the flora of Sri Lanka and is freely accessible at <http://www.science.cmb.ac.lk/tools/slflora> web address. Glucocorticoid receptor (GR) belongs to the super family of nuclear receptors and act as a steroid hormone trans-activated transcriptional factor expressed in almost all cells in the body. It is known to regulate growth, stress response, metabolism, homeostasis, immune function, and development. Cortisol is the main physiological ligand for the GR and in the absence of the ligand, GR resides in the cytosol in an inactive form associated with several chaperone proteins. The ligand binding domain of the GR intercedes to receptor activity via glucocorticoids. The molecular docking procedure with DOCK6 software was conducted to predict binding affinity of cortisol to GR protein and the binding affinity recorded. The same docking procedure was used for the

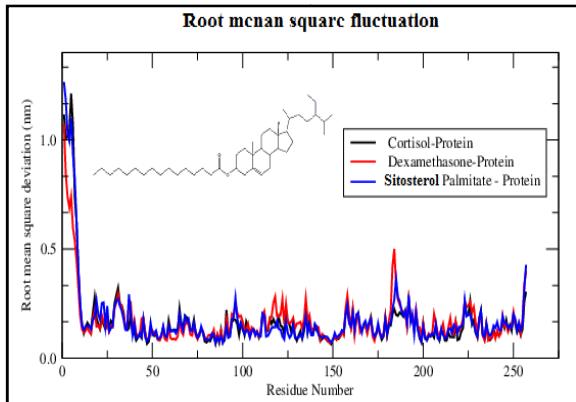
seven (07) steroids found from Sri Lankan flora and a *synthetic glucocorticoid, dexamethasone* and respective grid scores were recorded. Out of seven steroids only one, sitosterol palmitate, showed high binding affinity towards the GR. The complexes of cortisol, dexamethasone and sitosterol palmitate with GR were pursued for molecular dynamics (MD) simulation study for 30 ns each to investigate the stability of the complexes in aqueous

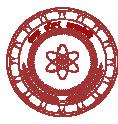
medium. The stability of the above systems was studied in terms of root mean square deviations (RMSD), radius of gyration ( $R_g$ ), root mean square fluctuations (RMSF) and total solvent accessible surface area (SASA). The MD analysis, specially the RMSF analysis indicates that cortisol, dexamethasone and sitosterol palmitate complexes behaved in a relatively similar manner in aqueous medium. Therefore, it could be concluded that the binding of sitosterol palmitate to GR as an agonist may produce biological effects similar to that produced by glucocorticoids and could be recommended for *in vitro* testing.

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**932/E3/Poster**

**Use of electroencephalography-based brain computer interfaces in the virtual classroom**

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Collaborative virtual environment-based learning systems facilitate participation in lectures from different geographical locations. These kinds of environments provide more interactivity over conventional distance learning methods such as message boards and chat capabilities, where input of the participants is partially ignored. Unlike in real classroom, the virtual classroom allows the participant to hide the real affective state and real participation. The proposed study will implement a prototype to express affective states of the participants as facial expressions and gestures of avatars, which represent participants in the virtual classroom. Electroencephalography (EEG)-based Brain Computer Interfaces (BCI) will be used to capture the brain signals. Brain signals will be preprocessed using Independent Component Analysis (ICA) and classification will be done using Linear Discriminant Analysis (LDA). The extracted affective states will be fed to the avatars of the virtual classroom. Second Life, a popular 3D virtual environment will be used for modeling virtual classrooms.

**Keywords:** EEG, BCI, virtual classroom, second life

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