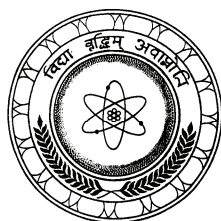


*Sri Lanka Association for the Advancement of Science  
Proceedings of the 63<sup>rd</sup> Annual Sessions – 2007, Part I - Abstracts*

# **Sri Lanka Association for the Advancement of Science**



*Proceedings of the 63<sup>rd</sup> Annual Sessions  
3 - 8 December, 2007*

## **Part I - Abstracts**

*Sri Lanka Association for the Advancement of Science - 2007*

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*Proceedings of the 63<sup>rd</sup> Annual Sessions*

*Part I - Abstracts*

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**Sri Lanka Association for the Advancement of Science**

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## SECTION A

001/A

### **The knowledge, attitudes and practices about lymphatic filariasis and the Mass Drug Administration Programme in school children of different ethnic groups residing in a filariasis endemic area of Sri Lanka**

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This cross sectional study compares the knowledge, attitudes and practices about lymphatic filariasis and Mass Drug Administration (MDA) programme, held by school children of two different ethnic groups; Sinhalese and Muslims, residing in a bancroftian filariasis endemic area in the Galle district of Sri Lanka. The population in this area has received five rounds of MDA from the anti-filarial campaign since the inception of the programme for elimination of lymphatic filariasis. 150 children from each ethnic group, attending grades 9, 10 and 11 were selected using stratified and systematic random sampling methods. A pre-tested structured questionnaire was administered by school teachers. Knowledge was assessed on epidemiology, transmission, clinical manifestations, diagnosis, prevention and the MDA campaign. Marks were given out of a total score of 100. All respondents had heard about lymphatic filariasis. The overall knowledge regarding the disease and the MDA programme was low among both groups of children with mean scores of less than 50.0 and no significant difference between the two groups. (Sinhalese: 49.95; Muslim: 47.08 and  $p=0.042$ ). The knowledge of the Muslim children with regards to the transmission and clinical features of filariasis was significantly better than that of Sinhalese children ( $p<0.001$  and  $p<0.001$ , respectively). A high proportion (88%) of children from both ethnic groups was aware of the role played by the mosquitoes in the transmission of the disease. However, their knowledge on the geographic distribution of the disease, clinical features, diagnosis and the preventive measures was poor as compared to that of transmission, as only 1% identified all three filariasis-endemic provinces, 19% was able to recognize a picture of elephantiasis, 56% were aware of the night blood sampling and only 43% named MDA as a preventive measure. Only 33% had mentioned the school system as a source of information. Hence, education on lymphatic filariasis should be emphasized in the school curriculum, especially with regard to the importance of consumption of drugs distributed for the MDA and vector control methods. Compliance to the Mass Drug Administration programme held in July 2006 was higher among Sinhalese (72%) than Muslim children (70%). A greater proportion of Muslim children (47.3%) than Sinhalese children (10%) admitted that they would avoid a person with elephantiasis. Emphasis should be placed on health education programmes to be concerned more on changing the attitudes and perceptions of the public regarding this neglected tropical disease.

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002/A

### **Night blood survey of a selected high-risk population for lymphatic filariasis**

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Human infection with *Wuchereria bancrofti* causes a disabling parasitic disease known as lymphatic filariasis, which is a major public health and socio-economic problem in many parts of the world. Little is known about the prevalence of filariasis among high-risk populations for filariasis. Objective of this study was to determine such prevalence of lymphatic filariasis among Mahara prison inmates whom the Anti Filaria Campaign (AFC) has identified as a high-risk group. All inmates of Mahara Prison were screened for Microfilariae (Mf) except those in special cells, by night blood film microscopy to determine the prevalence of infection from February to May 2007. All inmates were males of greater than 15 years. Of the 423 inmates screened, 15 were positive for Mf, giving a Mf positive rate of 3.55% in the study population and a mean Mf density of 5 Mf/60 µl blood, ranging between 4 to 9.2 Mf /60 µl of blood with a standard deviation of 2.49. The highest number of infected inmates was residents of Colombo and Gampaha districts where transmission is currently taking place. This is one of the few studies undertaken to date to determine the prevalence of bancroftian filariasis among inmates of a prison, a neglected population in Sri Lanka. This study indicates that the Mf rate of bancroftian filariasis in this study population is far greater than the 0.18% currently reported in the country. Therefore, an intensive programme is recommended to contain the spread of infection within this study population. For this, a proper screening programme combined with antifilarial treatment and vector control programme is urgently required.

Acknowledgements: Authors wish to acknowledge the financial assistance received from WHO/SEARO/TDR (grant no. SN 1152) and University of Kelaniya (Research grant no. RP/03/04/06/01/2006). Authors wish to thank Dr. Ravi Mudaliage, Senior Medical Officer, Prison's Hospital, Mahara, Ragama for his support and encouragement during field study activities. Authors also wish to thank Mr. M. Y. D. Dayanath, Ms. N.M. Ashoka Malanie, Mr. M.I.M.Peris, Mr. Y.L.Rassapana and other staff members of the Molecular Medicine Unit and Department of Parasitology, Faculty of Medicine, University of Kelaniya, Ragama for their assistance.

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003/A

### **Anthelmintic prescribing patterns of a sample of General Practitioners in the Colombo district of Sri Lanka**

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General Practitioners (GPs) provide first contact care for children and pregnant mothers in the community. This study ascertained the prescribing pattern of anthelmintics to children and pregnant women by a sample of GPs from the district of Colombo. From 13 Divisional Secretariat Divisions in the district, 10 Grama Niladhari divisions were selected randomly. 200 medical practitioners engaged in full time General Practice (100 urban and 100 rural), were selected randomly as clusters of 10 from each GN division. A pre-tested interviewer administered questionnaire was used to collect data. A total of 183 GPs participated with 94 being from urban areas. The majority of GPs were of the 31-40 year age group. 70% GPs were male. Almost 13% of GPs from urban areas had a Postgraduate degree in comparison to 4.5% from the rural areas. Over 50% of GPs had 6-20 years of service and over 30% treated 16-30 patients daily. 73% of GPs from rural areas accessed health related reading material daily or weekly. All GPs prescribed anthelmintics to children. Although nearly 80% of individuals preferred to de-worm at six month intervals, less than 40% from either actually did so regularly. Only 50% of urban and rural GPs commenced de-worming when the child was one year old. Pyrantel pamoate was the preferred anthelmintic used for children by both groups (63%). A higher

number of rural GPs (73%) prescribed Pyrantel pamoate than their urban counterparts (53%;  $p < 0.05$ ). Approximately 54% and 64% of GPs from urban and rural areas respectively, prescribed anthelmintics during pregnancy. A majority of GPs (61% urban and 86% rural) prescribed drugs after the first trimester. However, 25% from urban areas gave drugs during any trimester ( $p < 0.001$ ). More GPs from urban areas (84%) prescribed mebendazole ( $p < 0.001$ ) while those from rural areas (58%) gave albendazole ( $p < 0.001$ ). Regression analysis revealed that GPs with post graduate qualifications ( $\beta = 1.48$ ;  $OR = 4.39$ ) and those having frequent access to health related material ( $\beta = -1.23$ ;  $OR = 0.29$ ) prescribed anthelmintics to pregnant women more often than those without. Only 37% of urban and 24% of rural practitioners de-wormed the children at regular intervals. 46% of urban and 36% of rural practitioners failed to prescribe any anthelmintic to pregnant women.

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## 004/A

### Clinical manifestations of cutaneous leishmaniasis – further evidence from 200 patients

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Cutaneous leishmaniasis (CL), first described in Sri Lanka in 1992, is now recognized to be endemic. The aim of this paper is to add to the growing pool of information on CL in our population with further evidence from 200 new patients recruited prospectively from October 2004 to August 2006 for an ongoing study into genetic susceptibility to CL. The diagnosis of CL was based on demonstration of the presence of the parasite in cutaneous lesions by lesion aspirate, slit skin smear or culture. The clinical history, examination findings and investigation results were recorded and analysed. The patients were from 11 districts in Sri Lanka. A majority of 83 (41.5%) were from the Matara district. 143 (71.5%) were male. Ages ranged from 4 to 80 years [median age 32]. All were Sinhalese. A total of 225 cutaneous lesions were observed in these patients [mean 1.1 (range 1 to 4)]. The lesions were distributed over upper limb [114 (50.6%)], head and face [67 (29.7%)], lower limb [24 (10.6%)], back [12 (5.3%)], chest [7 (3.5%)] and abdomen [1 (0.4%)]. Of these lesions 136 (60.4%) had been present for less than 6 months, 218 (96.9%) displayed an onset and progression typical of localized CL [starting as a papule, enlarging, and subsequent ulceration], 129 (57.3%) were ulcerated, 131 (58.2%) were dry, 94 (41.8%) were wet, 186 (82.7%) were non itching, 205 (91.1%) were non tender, and 16 (7.1%) were secondarily infected. The surrounding skin was indurated, hypopigmented, hyperpigmented, or erythematous in 112 (49.8%), 103 (45.8%), 24 (10.6%), and 70 (31.1%), respectively. Twenty eight (12.4%) had satellite lesions and 5 (2.5%) had local lymphadenopathy. None had systemic features. Five (2.5%) reported similar lesions in the past which had healed spontaneously; 6 (3%) had diabetes mellitus; 11 (5.5%) had at least one other family member affected with CL. Multiple lesions were more likely to be of the dry type ( $P = 0.008$ ) and more likely to be associated with local lymphadenopathy ( $P = 0.008$ ) but were not associated with diabetes mellitus ( $p > 0.05$ ). The clinical characteristics observed in this group was similar to that described in previous studies done in Sri Lanka in 2002 on 65 patients. When cases are ascertained passively, it underestimates the true occurrence of the disease in a population, however, it is interesting to note that almost all those who deemed it fit to seek treatment for their condition were Sinhalese. In addition, those with multiple lesions were more likely to have affected relatives ( $P = 0.002$ ). This point

towards enhanced susceptibility to the condition among certain ethnic groups and/or individuals determined possibly by genetic factors.

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**005/A**

### **Prevention of antibiotic induced diarrhoea in dogs by fermented milk products**

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In the veterinary field the enormous use of strong antibiotics result in certain complications of dogs which may some times prolong the time of recovery. The beneficial bacteria in the gut can be killed by a number of antibiotics. Antibiotic-associated diarrhoea, especially with broad-spectrum antibiotics is a common clinical problem that the health personnel encounter in human and animal practice as well, even though it was not reported yet in Sri Lanka. The objective of this study was to confirm the phenomenon of diarrhoea induced by antibiotics and to assess the effect of locally manufactured yoghurt as a prophylactic measure to reduce antibiotic-associated diarrhea in dogs. This study was carried out at Warakapola, within a period of one month. Twenty male local dogs between 6 months and 1 year of age were divided into two groups namely Control 1 (n=10) and Test 1 (n=10). They were fed with a normal diet. The Test 1 animals were introduced with an initial dose of broad spectrum antibiotic doxycycline monohydrate orally at 25mg/Kg once daily, followed by 15mg/Kg for 5 days, after 7 days of the adaptation period. The control 1 group was not treated with the antibiotic. Another 20 dogs were divided into two groups namely Control 2 and Test 2 and the Test 2 was given antibiotics and 2 yoghurts (each 85 ml) per day containing live *probiotics* namely, *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. Control 2 was given only the antibiotics as in the Test 1 group. The dietary intake, the consistency of stools and the behavior were observed in all these groups. By 4<sup>th</sup> day of the treatment 7 out of 10 in the Test 1 had reduced appetite with watery diarrhoea. At 6<sup>th</sup> day other 3 also showed similar changes whereas the Control 1 group had normal appetite and bowel movement. Eight out of 10 in the Test 2 did not have anorexia and diarrhoea with the treatment of antibiotics whereas all dogs in the Control 2 developed the same clinical signs as in Test 1. The results showed that the fermented milk products containing live probiotics may help to maintain the gut microflora which are closely associated with prevention of developing diarrhea and anorexia. This can be applied under prevailing management practices to minimize the problems that owners and veterinarians encounter very often. Owners can be advised to introduce 2 yoghurts (each 85 ml) per day with oral antibiotics doses, which may improve the appetite of the dogs and the nutritional status resulting in promoting the prognosis. Further, complaints of normal anorexia of pets may be treated with fermented milk products with concurrent investigations.

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**006/A**

### **Potential use of blood-fed mosquitoes as evidence in forensic casework**

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Medico - criminal entomology has been an important source of evidence in forensic investigations for many years. However, it has not been widely used to provide direct evidence for personal identification in forensic casework so far. In this study, we made an attempt to determine the usefulness of human DNA extracted from blood-fed mosquitoes as evidence in forensic casework. Approximately 1500 adult female mosquitoes of same age from four different species, i.e. *Culex quinquefasciatus*, *Armigerus sabalbatatus*, *Aedes aegypti* and *Anopheles tessellatus* were fed with the same volume of human blood and maintained under the same environmental conditions. Three batches (N=1, 5 and 10) of randomly selected blood-fed mosquitoes were crushed and blotted onto filter paper strips separately at two hour intervals subsequent to blood meals up to 48 hours to determine the longitudinal variation in the extraction of polymerase chain reaction (PCR) amplifiable human DNA from mosquitoes. Human DNA was extracted from filter papers using a chelex-100 extraction protocol and amplified by PCR technique using human primers. Amplified products were run in 1.5% agarose gels. PCR amplifiable human DNA could be extracted from mosquitoes of *Cx. quinquefasciatus* and *An. tessellatus* up to 48 hours subsequent to blood meals. However, this duration was up to 46 and 42 hours in *Ae. aegypti* and *Ar. Sabalbatatus*, respectively. The amount of amplifiable DNA was inversely proportionate to the post-feeding duration, but increased with number of mosquitoes at each time interval. Amplifiable human DNA could be extracted even from a single mosquito of four different species even after 48 hours from a blood meal with slight variation among species. However, as the amount of DNA decreases with time interval, more mosquitoes will have to be used for extraction in late sample collections. Similarly, it may be required to use a highly sensitive PCR protocol when analyzing such samples. Blood-fed mosquitoes collected even after 2 days from a crime scene may be used as a source of direct evidence for personal identification in forensic casework.

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007/A

### Effect of silent transmission and clustering of cases on transmission of dengue in Gampaha district

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Silent transmission of dengue virus and clustering of cases have been suggested as possible factors for the increasing incidence of dengue fever. Objective of this study was to determine the presence of silent transmission and clustering of cases of dengue fever in the Gampaha District. Study was carried out using cluster investigation method. A cluster consists of family members and immediate neighbours (minimum of 20) of a dengue index-case. Serum samples from volunteers were tested for anti-dengue antibodies using Dengue-Duo-IgM/IgG Rapid Cassette (Panbio diagnostics, Australia). Using 7 index cases, 148 volunteers (68 Males); mean age: 35.9 years were enrolled. Of the 148, 41 had evidence of exposure to dengue virus [positive for IgM: 68.4% (28/41), IgM & IgG: 17% (7/41) and IgG: 14.6% (6/41)]. Out of 28 primary infections, 71.4% (20/28) were asymptomatic. Of the 7 secondary infections, 14.28% (1/7) was asymptomatic. Of the 6 previous exposures to dengue, 4 (66.67%) were asymptomatic. There was no significant association between sex and exposure to infection [31% (21/68) males vs 25% (20/80) females,  $p>0.05$ ] or between sex and occurrence of

symptoms among exposed individuals [71% (15/21) males vs 50% (10/20) females,  $p > 0.05$ ]. Older individuals aged over 40 years, were most likely to be asymptomatic than younger persons (94% (14/15 exposed) vs 50% (13/26 exposed),  $P < 0.01$ ). Out of 7 clusters investigated, 1 had  $> 50\%$ , 4 had  $> 25\%$  and 2 had  $< 25\%$  clustering effects. A high proportion of asymptomatic infections were observed among adults over 40 years without gender difference. Study suggests persistence of silent transmission of dengue virus with a trend towards clustering around cases.

Acknowledgement: World Health Organization (WHO/SEARO SN1144) and technical co-operation by International Atomic Energy Agency (TC/SRL 06/28)

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008/A

**A comparative field study of novel commercial Antigen Detection Enzyme-Linked Immunosorbent Assay (ELISA) with Reverse Transcription Polymerase Chain Reaction (RT-PCR) assay for early definitive laboratory diagnosis of dengue viral infection in Sri Lanka**

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Dengue is an important mosquito borne viral infection in South East Asia. Early definitive laboratory diagnosis of infection would help in management of patients and reducing the case fatality rate. The objective of this study was to determine the accuracy of novel commercial Antigen Detection Enzyme-Linked Immunosorbent Assay (ELISA) using Non Structural protein 1 (NS1) (Bio Rad) for early definitive laboratory diagnosis of dengue infection under field conditions in Sri Lanka. A panel of acute serum samples collected from 99 patients clinically suspected of having dengue fever ( $\leq 5$  days) warded at the North Colombo Teaching Hospital, Ragama, Sri Lanka were used for the present study. Serum samples were tested using Antigen Detection ELISA according to the method described by the manufacturer. Results of this novel assay were compared with RT-PCR assay using Chi-squared test. Two variables were analyzed at a 95% confidence interval and P value  $< 0.05$  was considered as significant. Twenty two and 65 patients were positive and negative, respectively, for dengue infection by both assays. Nine patients were confirmed as dengue by the Antigen Detection ELISA only. Three patients were confirmed as dengue by RT-PCR assay only. Antigen detection ELISA showed 88% of agreement with the RT-PCR assay. According to the Chi-squared test, there was no significant difference between the two assays for early diagnosis of dengue infection ( $\chi^2=46$ ,  $P=0.0000$ ). Novel commercial Antigen Detection ELISA kit (Bio-Rad 72830) can be used for early definitive laboratory diagnosis of dengue infection in Sri Lanka under field conditions.

Acknowledgement: the International Atomic Energy Agency (SRL 06/28) for technical co-operation and APCOT Marketing LTD, Sri Lanka for supplying Antigen detection ELISA kits.

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009/A

### Co-existence of double serotypes of dengue in patients of Gampaha District

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Dengue virus (DENV) known to cause a productive cytolytic infection in humans exists in four different serotypes Dengue 1 (D1), Dengue 2 (D2), Dengue 3 (D3) and Dengue 4 (D4). Among 4 serotypes of DENV, D 3 thought to be associated with explosive DHF epidemics and severe disease in many countries. Our objective was to determine the prevalence of dengue serotypes in Gampaha District and to correlate them with disease severity. Serum samples were collected from patients who were within 4 days of onset of fever and clinically suspected of dengue according to WHO criteria. Total viral RNA extracted from each serum sample was subjected to RT-PCR followed by a semi-nested PCR using specific primers. Out of 91 samples collected between Nov 2005 and Dec 2006, 16 samples were confirmed positive for DENV RNA by RT-PCR. Our results of multiplex semi-nested PCR indicated that 9/16 (56.25 %) of the positive cases were co-infected with serotype 2 and 3 (D2 & D3), while 4/16 (25%) were infected with D 3 and 3/16 (18.75 %) with D 2. 3/4 of D 3 cases had DHF , 1/3 of D2 cases were DHF while there were no DHF cases among the D2 and D3 co-infected patients. The mean Packed cell Volume (PCV) values of D3, D2 and D2 & D3 co-infected were 53.8 %, 48 % and 39.6% respectively while the mean platelet values of those were 66,000 mm<sup>3</sup>, 123,000 mm<sup>3</sup> and 174.000 mm<sup>3</sup>, respectively. Dengue infection by a single serotype is common among patients. Although few cases of co-infection by more than one serotype had been previously reported in a few other countries, this is the first description of simultaneous co-infection by D2 and D3 in Gampaha district. In this limited study we have observed a reduction of disease severity in D2 and D3 simultaneously co-infected patients. Could simultaneous co-infection by more than one serotype or a combination of two particular serotypes have lead to a decrease in disease severity among dengue patients is a matter yet to be studied. Further studies are needed to support these conjectures and to establish the clinical implications of simultaneous co-infection on the prevalence of DHF and disease severity.

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010/A

### Most productive and prevalent breeding habitats of *Aedes aegypti* and *Ae. albopictus* (pupae) in the Kandy and Nuwara Eliya districts of Sri Lanka

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Breeding habitats of *Aedes aegypti* and *Ae. albopictus* in the Kandy and Nuwara Eliya districts were studied from April 2006 to April 2007. Surveys of *Aedes aegypti* and *Ae. albopictus* immatures were carried out in 101 localities in the Divisional Director of Health Services (DDHS) areas of Akurana, Doluwa, Gampola, Gangawatakorale, Hanguranketha, Kundasale, Medadumbara, Nawalapitiya, Pathadumbara, Pathahewaheta, Poojapitiya, Tumpane, Udunuwara, Werallagama, Yatinuwara and in

the Kandy Municipal Council area. During each survey, all potential indoor and outdoor breeding habitats of *Ae. aegypti* and *Ae. albopictus* were examined. *Aedes* larvae and pupae, 10 of each, were randomly collected from each mosquito immature positive habitat by dipping, pipetting or straining (if a particular habitat had < 10 larvae/ pupae, all larvae/ pupae were collected). Larvae and emerged adults from pupae were identified using larval and adult identification guides. Twenty two (22) types of container habitats were positive for *Ae. aegypti* and *Ae. albopictus* larvae. Of these 14, were positive for *Ae. aegypti* and or *Ae. albopictus* pupae. Pupal container index (percentage of containers positive for *Ae. aegypti* and / or *Ae. albopictus* pupae) of different types of container habitats were: metal ware (11.59%), unprotected plastic tanks (8.33%), roof gutters (7.14%), tyres (5.69%), polythene bags/sheets (3.85%), ornamental ponds (2.97%), coconut shells (2.67%), refrigerator trays (1.87%), water storage barrels (1.73%), clay pots (1.48%), water storage cement tanks (1.41%), tins (0.75%), leaf axils (0.72%) and discarded plastic containers (0.60%). However, water storage cement tanks (35.09%), water storage barrels (18.45%), discarded plastic containers (15.43%), refrigerator trays (7.13%), clay pots (5.40%) and tyres (4.91%) constituted the majority (86.41%) of potential breeding sites of *Ae. aegypti* and *Ae. albopictus*. Management of mostly prevalent and pupae positive containers would reduce the adult *Ae. aegypti* and *Ae. albopictus* density and consequently the dengue and dengue haemorrhagic fever incidence in the Kandy and Nuwara Eliya districts.

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011/A

### **Application of spray drying and ethanol extraction technologies in manufacture of *Triphala Kwatha***

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Ayurveda has been recognized as one of the medical systems, by locals and internationals for many reasons. Of natural drug formulations, *kwatha* (decoction) is the most effective and popularly used counterpart. Despite their popularity, production of these formulations with extended shelf life at larger scale is extremely difficult. A study was carried out to establish a protocol for novel presentation form of *triphala* (*Terminalia chebula*, *Terminalia bellarica*, *Embellica officinalis*) *kwatha* which was prioritized by a preliminary survey on the recommendations made by Ayurvedic practitioners. The *Triphala* decoction was prepared in three different ways; as per a traditional decoction recipe, spray drying of concentrated decoction and ethanol extraction. As for the traditional form, ingredients were added to water and boiled, to reduce the volume. Similarly, another sample was prepared using the same method which was spray-dried by using a lab scale spray dryer. The ethanol extraction was prepared by using 70% ethanol. Then it was strained after one week and rotavaporised to remove the ethanol fraction. Spray dried and ethanol extracted samples were separately dilute in the same volume of water, before the comparative sensory and physio-chemical tests were carried out, based on the original recipe and procedure. The results obtained were statistically analyzed by using one way ANOVA followed by the Tukey's test. The corresponding P values were significantly the same for the three samples at the level of 0.05 with regard to pH, total fat content, odour and taste (P=0.681 P=0.182 P=0.282 P=0.906). Although the corresponding P values for the specific gravity, the refractive index and the tannin content were significantly different, the colour, consistency (P=0.000) and total soluble solids (p=0.058) of these three forms remained the same. When using the Tukey's multiple comparison test for this significantly different variables, the refractive index, total soluble solids, colour and consistency were significantly the same in

traditional *kwatha* and reconstituted spray dried powder. Traditional and spray-dried forms contained more soluble solid particles than the ethanol extraction. The colour of the spray dried preparation showed no significant difference when compared with that of the traditional decoction. With respect to specific gravity and tannin content, means of all three forms were significantly different from each other. The results of the reconstituted spray-dried sample showed a similar thin layer chromatography distribution pattern compared with that of the traditional product. It can be recommended that spray drying method be used as an alternative method to the traditional method of *tripphala kwatha*.

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012/A

### **A study of total viable count of micro organisms, and specific microorganisms in Ayurvedic compound preparation of *Chandra Kalka***

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*Chandra kalka* is a popular Ayurvedic medical preparation containing mainly plant materials. All such materials contain natural inherent microbial flora and further contamination may occur during preparation. Considering these facts the World Health Assembly in its resolutions WHA-31:33, 40:33, and 42:43 has emphasized the need to ensure the microbial quality standard of medicinal plant products. *Chandra Kalka* is being used in therapeutics for over several hundred years, in respiratory tract disease conditions. The main objective of this study was to enumerate the total viable count of bacteria, fungi and the specific microorganisms such as *Coliforms* and *Salmonella* in this drug. Fifteen market samples of five manufactures were studied. Three different samples of each manufacture with different manufacturing dates were selected for the study. Nutrient agar and Potato Dextrose agar were used as common culture media for counting bacteria and fungi, respectively. Routine sterilization processes were followed to sterilize the culture media and Glassware. 0.1 gram of the above drug was dissolved in 10ml of sterile distilled water and three dilutions of  $10^{-1}$ ,  $10^{-2}$ ,  $10^{-3}$  were made. 0.1ml of these solutions was used to study the microbial load. Pour plate and spread plate techniques were used to culture bacteria and fungi. Microbial counts were taken after 24 and 72 hours. It was assumed that each colony was formed by a single organism. Testing for organisms Coliform was done with single strength MacConkey broth using most probable number technique. Test for Salmonella was performed according to the International Standards. The same procedures were repeated three times to confirm the colony count and the presence of specific microorganisms. The results obtained in this study indicate the presence of bacteria and fungi in this preparation. None of the drug samples was positive for Coliforms or *Salmonella*. According to the limits adapted from the provisional guide lines established by World Health Assembly, the microbial colony counts observed in this study were within the limits acceptable by W.H.A. (Aerobic bacteria, maximum  $10^5$  per gram; yeast and moulds, maximum  $10^3$  per gram; *Escherichia coli*, maximum 10 per gram; Other enterobacteria maximum  $10^3$  per gram; *Salmonella* none). These results were statistically analyzed by using student T- test. Mean of the colony count was not significant at 0.05. There was no difference of standard mean of the colony count and sample colony count. These results scientifically evaluated that the samples tested have been prepared according to the microbial quality standards and are microbiologically safe.

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013/A

### Effect of whey protein on angiotensin converting enzyme activity and lipid profile in *Wistar* rats

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The whey protein that contributes approximately 18% of the total milk protein mainly consists of  $\alpha$ -lactalbumin,  $\beta$ -lactoglobulin, bovine serum albumin immunoglobulin and glycomacropeptides. Angiotensin II is formed from Angiotensin I by Angiotensin converting enzyme (ACE). Angiotensin II controls the blood pressure via promoting vasoconstriction and sodium water retention. The effect of prolonged intake of whey with respect to ACE activity and lipid profile in *Wistar* rats was investigated. Whey fraction was isolated by filtering the curd through a muslin cloth. The pH of the filtrate was adjusted to 4.6 in order to precipitate any casein remaining. The samples were centrifuged at 10,000 g to remove any excess fat remaining and the pH was adjusted to 7. Fourteen rats were divided into two groups of seven and 2 ml of whey extract was given to one group while the other group (control) was given 2ml of drinking water, via gastric intubation for a period of eight weeks. Blood samples were collected from the lateral tail vein after 12-14 h fasting. Serum samples were analyzed for ACE activity after modification of the method described by Cushman DW and Cheung HS (1971), total cholesterol, HDL cholesterol, & triglycerides were analyzed by a commercially available kit at the beginning and after eight weeks of the experiment period. The whey fed group had a reduction of 3.2% in the body weight, 0.7% in the ACE activity, 5.4% in the total cholesterol, 0.09% reduction in the HDL cholesterol, and 4.5% reduction in the serum triglycerides levels, respectively. The percentage difference in serum total cholesterol showed a significantly lower value ( $P < 0.05$ ) when compared with the control. However, the other parameters assessed did not show any significant difference when compared with the control. This suggests that whey can reduce serum total cholesterol in rats. The cholesterol lowering activity of whey may be due to the formation of short chain fatty acids by the lactic acid fermenting bacteria present in curd.

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014A

### Possible curative effect of an Ayurvedic medicinal paste on cobra (*Naja Naja*) envenomised laboratory mice

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The venom of cobra (*Naja naja*), one the most dangerous species in the 0 Indian subcontinent, consists of different types of toxins. These toxins act on neurons, muscle and local tissues and the clinical picture of the patient varies according to the proportions injected and effects of toxins.

Ayurvedic treatment for cobra bite victims had been in use for generations while Anti Venom Serum (AVS) with other symptomatic treatments is administered in Western medical therapy. Objective of the present study was to investigate on the survival time of cobra envenomised mice with and without applying an ayurvedic medicinal paste. Twenty four mice were divided in to 3 groups of equal size (Groups 1, 2 and 3). All mice were pricked on their thighs with an 18G hypodermic needle to simulate a cobra bite and a total volume of 0.1ml of serially diluted fresh cobra venom doses were injected using an insulin syringe. The doses (protein concentration) of injected venom were 25 mcg, 50 mcg and 100 mcg per mice, for groups 1, 2 and 3, respectively. Four mice from each of the 3 groups, were applied with the ayurvedic medical paste immediately afterwards. The medicinal paste was made using Yakawanassa (*Anisomeles indica*), Yakberiya (*Crotolaria laburnifolia*), Ekaveriya (*Rauvolfia serpentina*), Maduruthala - (*Ocimum sanctum*), Sassanda (*Aristolochia indica*), Kaha (Atkaha) - (*Curcuma longa*) and Karanda (Magul Karanda)- (*Pongamia glabra*). A control group of 4 mice were applied with the ayurvedic paste immediately after the simulated cobra bite in order to examine any effect of the paste only. The 4 mice treated with paste in Group 1 (25 mcg), lived relatively longer (391 Minutes), compared with the non treated mice (198 Minutes) in the same group. However, such indication on possible protective effects was not evident at higher concentrations of venom, in Groups 2 or 3. Therefore, it may be concluded that the ayurvedic medicinal paste under test has a beneficial effect only at the lowest concentration of venom used. At lower concentrations of the venom, the paste may have a local effect possibly by interfering with absorption of venom to the body and also reducing the local tissue reactions. The death of mice in groups 2 and 3 (higher concentrations of venom), despite the application of paste, could be due to acute action of venom on the nervous and muscular - skeletal system. Histo-pathological investigations on the effects of ayurvedic medicinal paste on tissues in mice, would confirm the present results. Further studies are recommended to investigate the possibility of using endogenous medicine concurrently with western medications, in order to improve positive response rate and prognosis, in cobra bite victims.

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**015/A**

**Herb-drug interactions: The effects of coriander (*Coriandrum sativum*) seed extract on serum paracetamol levels in rat**

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Paracetamol is considered to be one of the safest over-the-counter drugs which is used to relieve mild to moderate pain. However hepatotoxicity may result in paracetamol over dosage due to its metabolism via a Cytochrome P450 enzyme dependant pathway. Coriander extract obtained from seed has been used for home therapy in Sri Lanka for common cold and fever and sometimes taken together with paracetamol. Herbal medicines sometimes interact pharmacokinetically and pharmacodynamically, with prescription medications. The present study was carried out to investigate the effect of coriander extract on serum paracetamol levels in rats. Single dose of paracetamol was administered (108.5g/kg body weight) with water (n=5) or coriander extract (n=6) to Sprague-Dawley rats. Blood was drawn at different time intervals over a period of 25 hours. Serum paracetamol levels were analysed by reverse-phase high performance liquid chromatography with electrochemical detector. Paracetamol was rapidly absorbed when administered with coriander extract compared to water. The time taken to achieve the peak serum concentration (Tmax)  $\pm$ SEM was 0.625 $\pm$ 0.08h following administration of paracetamol with coriander extract in contrast to 1.05 $\pm$ 0.20h with water. Further constituents of coriander extract increased the peak serum paracetamol concentration by 1.3

folds ( $P=0.001$ ) and maintained at a higher level ( $P<0.05$ ) over the first 45 mins. The area under the curve ( $AUC_{0-24}$ ) increased by 1.5 folds ( $P=0.032$ ) and elimination half life decreased by 1.8 fold ( $P=0.02$ ) when coriander extract was given. These results suggest that co-administration of paracetamol increases the serum paracetamol levels in rats. Considering the above findings, similar studies in humans are needed to evaluate the safety and effective use of drugs with herbal medicines.

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016/A

### Investigation of the antioxidant activity of a herbal decoction with anti-carcinogenic properties

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*Nigella sativa* (seeds), *Hemidesmus indicus* (root), and *Smilax glabra* (rhizome) are three important medicinal plants used for anti-cancer treatment by a family of indigenous medical practitioners in Sri Lanka. Recent *in vivo* investigations have demonstrated that a decoction prepared from *Nigella sativa* (seeds), *Hemidesmus indicus* (root), and *Smilax glabra* (rhizome) can offer significant protection against diethylnitrosamine (DEN) induced hepatocarcinogenic changes in rats. According to published literature, antioxidant activity is one of the mechanisms by which many plants and plant compounds mediate their anti-carcinogenic action. The aim of the present study was to investigate the antioxidant activity of the decoction comprising of *Nigella sativa* (seeds), *Hemidesmus indicus* (root), and *Smilax glabra* (rhizome) in order to assess its claim for anti-hepatocarcinogenic effects. For experimental purpose, 6 weeks old healthy male Wistar rats ( $n=40$ ) were randomly divided into four equal groups. Hepatocarcinogenesis was induced in two groups (group 3 and 4) by single intra-peritoneal injection of DEN (200mg/kg body weight). After two weeks of DEN induction, partial hepatectomy was performed under general anaesthesia to promote the carcinogenesis. Animals in groups 2 and 4 were orally treated with the decoction at a dose of 6g/kg body weight/day for ten weeks, and they served as decoction control and test, respectively. Groups 1 and 3 were given 0.9% NaCl orally for ten weeks and they served as distilled water and DEN control, respectively. The levels of thiobarbituric reactive substances (TBARS), reduced glutathione (GSH), and activities of antioxidant enzymes were assessed in the haemolysate and liver homogenate of experimental animals by standard methodologies. In animals subjected to DEN induction, a significant increase ( $P<0.05$ ) in liver TBARS was observed, while the levels of GSH and activities of antioxidant enzymes – superoxide dismutase, glutathione peroxidase and glutathione s-transferase decreased significantly ( $p<0.05$ ). Altered TBARS, GSH and antioxidant enzyme levels were ameliorated significantly ( $p<0.05$ ) by oral administration of the decoction at a dose of 6g/kg body weight/day (effective anti-hepatocarcinogenic dose as demonstrated in previous investigations) for a period of ten weeks. The present results suggest that antioxidant activity may be one of the mechanisms by which the decoction comprised of *Nigella sativa* (seeds), *Hemidesmus indicus* (root), and *Smilax glabra* (rhizome) exerts its chemopreventive effects during DEN induced hepatocarcinogenesis. Although each of the three plants used in the preparation of the decoction have been reported previously to possess antioxidant properties, the present study is the first to demonstrate that a combination of the three plants can enhance the antioxidant status of rats in which hepatocellular carcinogenic changes have been induced.

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017/A

**K76T point mutation of chloroquine resistance transporter gene: Is it a potential molecular marker for chloroquine resistance in Sri Lankan *Plasmodium falciparum* isolates?**

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Current evidence suggests that K76T mutation of chloroquine resistance transporter (*Pfcr*t) gene may be used as a molecular marker for chloroquine (CQ) resistance of *P. falciparum*. This study was carried out to determine the frequency of K76T mutation of *Pfcr*t gene in Sri Lankan *P. falciparum* isolates collected from Mannar district in the Northern Province. Mutation patterns were compared with *in vitro* and *in vivo* CQ failure rates for this parasite population to analyze its association with resistance to CQ and to calculate the genotype-resistance (GRI) and genotype-failure (GFI) indices for K76T mutation. *P. falciparum* DNA was extracted from dried blood spots using a QiaAmp DNA Blood Mini Kit. Mutation patterns at 76 codon of *Pfcr*t of field isolates were detected using a polymerase chain reaction – restriction fragment length polymorphism assay. Parasite isolates were categorized into wild (sensitive) and mutant (resistant) types based on the banding patterns of digested products on 2% agarose gels. GRI and GFI indices were calculated for this parasite population. Of 38 CQ resistant isolates, 86.8% (N = 33) showed the mutant allele (K76T) at codon 76 of *Pfcr*t. There was a statistically significant association between the presence of K76T mutation and *in vivo* resistance to CQ ( $\chi^2 = 5.11$ ,  $p = 0.02$ ). Of 33 sensitive isolates, 39.4% (N = 20) possessed the wild type allele at the same codon position. The calculated GRI and GFI indices were 1.13 and 1.38 respectively for this area. Even though results show a statistically significant association between the presence of K76T allele and CQ treatment failure of *P. falciparum* isolates in the study population, its mere presence alone does not seem to correlate with resistance to CQ. Therefore, mutations at other codons of *Pfcr*t shown to accompany K76T mutation as well as those in *P. falciparum* multi drug resistance 1 (*Pfmdr*1) gene need to be analyzed to determine whether other mutations play a role together with K76T in clinically resistant Sri Lankan parasite isolates. More studies are required to validate the calculated GRI and GFI values, which may be used to predict the therapeutic failure of CQ in a particular area in Sri Lanka in the future.

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018/A

**Patterns of anti-PvR11 IgG and IgG isotype responses to *Plasmodium vivax* Duffy Binding Protein in Sri Lanka**

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Exploring the nature of the antibody response to potential vaccine candidates, during natural malaria infections would provide essential information for vaccination strategies. Recombinant protein PvRII, that represents native *Plasmodium vivax* Duffy Binding Protein, was used in an ELISA to assess the magnitudes of IgG and IgG isotype responses in acute vivax malaria patients. Serum samples that screened positive for anti-PvRII total (IgG+IgM) antibodies in a previous study were pre-selected for this assay from non-endemic Colombo (N=58), and from two endemic areas, Anuradhapura and Kataragama (N=48 from each area). The percentage of responders (prevalence) with anti-PvRII IgG was 71%, 79% and 67% from Colombo, Anuradhapura and Kataragama, respectively. No significant differences were detected among the proportion of responders (Chi square,  $P>0.05$ ) and mean anti-PvRII IgG magnitudes (Kruskal-Wallis,  $P>0.05$ ) among the three study populations. Cytophilic IgG3 was the most prevalent IgG isotype in all three-study cohorts. No significant difference was observed for prevalence of IgG isotypes between the three areas, with the exception of the significantly higher prevalence of IgG3 in Colombo than in Kataragama (Chi square,  $P<0.05$ ). The prevalence of IgG3 was significantly higher than the other three isotypes within the residents of Colombo. However, in both endemic areas no significant difference was apparent between the prevalence of IgG3 and IgG1 (McNemar,  $P<0.05$ ). In all test areas, prevalence of restricted IgG3 responses to PvRII was significantly higher (Chi square,  $P<0.05$ ) than for responses restricted to each of the other 03 isotypes. Significantly higher magnitudes of IgG1 than the other IgG isotypes (Wilcoxon Signed ranks,  $P<0.05$ ) were detected within each test area. A significantly higher IgG1 magnitude was detected in Colombo than in Kataragama (Mann-Whitney U Test,  $P<0.05$ ). Both the prevalence and magnitudes of total IgG and of IgG isotypes were independent of age of patients or their previous exposure to malaria or to their parasite burden. These results may imply that cytophilic antibody isotypes IgG1 and IgG3 may play important roles with regard to the immune response to PvDBP in Sri Lanka.

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## 019/A

### Nocturnal human biting behavior of *Anopheles culicifacies* in a hydro electric power project area situated in a sylvatic environment in the Central Province of Sri Lanka

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Nocturnal human biting behavior of *Anopheles culicifacies* was studied from January 2006 - March 2007 at the Victoria hydro electric power generation project area in the Central Province of Sri Lanka. Monthly collections of indoor and outdoor, landing and biting, mosquitoes were made from 1700 - 0600 hours (13 hours) using 3 - 4 indoor and 4 -8 outdoor human baits. In each collection, human baits were seated with exposed hands and legs below the knees. Hourly collections of landing and biting mosquitoes on the exposed surfaces of the body using torches and aspirators were made and mosquitoes were identified to species. Data was summarised as the number of *An. culicifacies* collected indoors and outdoors each hour/bait separately. The majority (97.83%) of *An. culicifacies* bit outdoors as compared to indoors. There were monthly variations in the biting habits with the highest

densities being observed from February to April. *An. culicifacies* bit throughout the night with peak biting hours from 2200 - 2400 hours. Previous studies indicated that the peak biting hours were earlier in the evening and the morning. Further studies are required to study the nocturnal human biting behavior of *An. culicifacies* in other areas of Sri Lanka since this information is very important in planning malaria control activities. However, preventive measures directed to protect the outdoor workforce in the Victoria project should be a priority. If space spraying is planned, it should be carried out between 2200 – 2400 hours to cover the peak biting period of *An. culicifacies* in the project area.

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## 020/A

### Evaluation of reproductive hormone profile in relation to semen quality in male partners of subfertile couples

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The objective of the study was to assess the reproductive hormone profile of a Sri Lankan subfertile male population and to relate it to their semen parameters. Male partners of 152 subfertile couples who sought treatment at the subfertility unit of the department of Obstetrics and Gynaecology at the Faculty of Medicine, Ragama were included in the study. Serum samples were assayed for follicle stimulating hormone (FSH), luteinizing hormone (LH), prolactin (PRL), Estradiol (E2) and testosterone (T) levels, using electrochemiluminescence immunoassay (ECLIA). A semen sample was obtained from each participant on the same day. Seminal fluid analysis was done according to the WHO guidelines. The mean (SEM) of FSH, LH, PRL, E2 and T levels of the males were 5.35 (0.53) mIU/mL, 6.20 (0.33) mIU/mL, 17.53 (0.60) ng/mL, 30.48 (1.80) pg/mL and 523.80 (14.74) ng/dL and the prevalence of abnormalities of these hormones were 9.8% (n=15), 5.9% (n=9), 13.15% (n=20), 0.6% (n=1) and 2.6% (n=4) respectively. Of the study population 20.3% (n=31) men had either single or combination of hormone abnormalities. When the mean hormone levels of the men with normal semen parameters were compared with those of men with abnormal semen parameters, none showed a statistically significant difference; FSH - 4.18 (2.78) Vs 4.58 (3.15), LH - 5.90 (2.78) Vs 5.70 (2.36), PRL - 28.63 (14.96) Vs 17.59 (7.63) and T -551.39±208.17 Vs 515.73 (158.25). Mean (SD), FSH and LH levels were significantly higher among azoospermic participants compared with normozoospermics; 19.69 (9.93) Vs 4.18 (2.78) for FSH, 12.82 (11.82) Vs 5.90 (2.78) for LH, p<0.01). Similarly FSH and LH levels were significantly higher in severe oligospermic participants compared with the normozoospermics; 7.58 (4.34) Vs 4.18 (2.78) for FSH, and 6.96 (2.65) Vs 5.90 (2.78) for LH, p<0.05). The serum FSH level showed an inverse correlation with sperm concentration (r= -0.203, p<0.05) and total sperm count (r= -0.206, p<0.05). In conclusion, an endocrinopathy was present in up to 20% of this population. Abnormalities in Gonadotrophin levels were related with azoospermia and severe oligozoospermia. Serum FSH showed a negative correlation with the sperm concentration and the total sperm count. Other hormones failed to show a significant relationship with the semen parameters in this population.

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021/A

### Re-emergence of chikungunya in Sri Lanka: First confirmation of the 2006 outbreak by molecular diagnosis

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Chikungunya virus infection is clinically similar to many other acute febrile illnesses, such as dengue infection, malaria, west nile fever and leptospirosis. Rapid confirmation of the outbreak by laboratory diagnosis is important to ensure public health safety by appropriate patient management and controlling the disease. Molecular diagnosis by Reverse Transcriptase- Polymerase Chain Reaction (RT-PCR) assists rapid diagnosis. The objective of the present study was to determine the clinical manifestations of chikungunya confirmed patients in Sri Lanka. Venous blood samples and clinical information were collected from 66 chikungunya suspected patients having fever of less than 4 days from different geographical areas in Sri Lanka during the period September 2006 to February 2007. Serum samples were tested for chikungunya RNA by RT-PCR. Amplified products were visualized by agarose gel electrophoresis. Among 66 suspected patients, 51% (34/66) were positive for chikungunya by RT-PCR assay and 55.9% (19/34) were females. All age groups were affected similarly with the mean age of 41 years (range = 4 months to 80 years). Of the PCR positive 34, all had fever with either arthralgia or arthritis or both. Most of them had only pain in the joints without swelling (arthralgia only); 67.6% (23/34) in knee, 55.9% (19/34) in ankle, 50% (17/34) in wrist, 44.1% (15/34) in elbow and 52.9% (18/34) in small joints. Arthritis of ankle joint 35.2% (12/34) was more frequent compared with arthritis of the knee joint 17.6% (6/34). PCR positive patients manifested more symptoms compared with PCR negative patients; 85.3% (29/34) headache, 79.4% (27/34) backache, 58.8% (20/34) nausea and 61.8% (21/34) vomiting. Compared with dengue, most of the chikungunya patients did not have dermatological manifestations. This is the first confirmation of the 2006 chikungunya outbreak in Sri Lanka. Some of the patients who had symptoms suggestive of chikungunya, tested by PCR were negative. These patients were probably suffering from other illnesses such as dengue.

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022/A

### Sildenafil citrate in diabetes mellitus patients with erectile dysfunction double blind placebo controlled crossover clinical trial

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The objective of this study was to assess the efficacy, acceptability and side-effects of oral sildenafil citrate in diabetes mellitus patients with erectile dysfunction. 103 diabetic patients with erectile dysfunction who are attending the Endocrine Clinic at National Hospital of Sri Lanka were selected for the study. Sildenafil citrate 50mg or placebo was given to alternate patients and after a wash-out period of 2 weeks, those who were initially given the drug were given the placebo and vice versa. 5 item version of International Index of Erectile Function (IIEF-5) was used to assess the degree of erectile dysfunction. IIEF-5 was assessed before giving any treatment and after the placebo and the drug. Ninety five (92.3%) patients completed the study. There was a significant improvement ( $P < 0.001$ ) in IIEF-5 after treating with sildenafil citrate (IIEF-5 mean 17.1) when compared with placebo (IIEF-5 mean 10.7). 48 (50.5%) patients had at least a single side-effect attributed to the drug. These adverse effects were transient and mild in nature including nasal congestion, gastrointestinal disturbances, visual disturbances, headache, dizziness and faintishness in order of significance. 92 (96.8%) patients said that the use of sildenafil citrate was acceptable to them. It could be concluded that sildenafil citrate is an effective drug in the management of erectile dysfunction in diabetic patients. Side effects of sildenafil citrate are transient and mild. Patients expect clinicians to diagnose and treat erectile dysfunction appropriately.

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**023/A**

**Determination of rheumatoid factor profile and its associations with clinical manifestations and socio economic factors of rheumatoid arthritis patients in Sri Lanka**

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Gaining insights into immunological and socioeconomic aspects of rheumatoid arthritis (RA) are of key importance in the proper management of the disease. A case control study was undertaken to assess the rheumatoid factor (RFs) profile and to sort associations with serum immunoglobulins, clinical manifestations, and to study the socio-economic status of RA patients in Sri Lanka. The study cohorts consisted of seropositive (+RF) RA (N = 100), and age-gender matched seronegative (-RF) RA (N = 57) and osteoarthritis (OA) (N = 30) patients from the National Hospital, Sri Lanka. Age-gender matched normal healthy individuals (NH) served as controls (N = 30). Modified indirect ELISAs were established to assay serum RFs (IgM-RF and IgG-RF). Socio-economic factors and clinical manifestations were accrued via an interviewer - administrated questionnaire. A significantly higher level of IgM-RF was evident in +RF sera than in the control cohorts (ANOVA;  $P < 0.05$ ). The magnitude of IgG-RF of +RF patients was significantly higher than in OA patients and NH controls (ANOVA;  $P < 0.05$ ). The magnitude of IgG-RF of +RF patients was significantly higher than the OA and NH cohorts (ANOVA;  $P < 0.05$ ). +RF, -RF and OA disease specific correlation matrices of serum RFs and immunoglobulins were evident for the first time in Sri Lanka. Gender was not significantly associated with the level of IgM-RF and IgG-RF of the +RF patients (Mann-Whitney U test;  $P > 0.05$ ). A significant correlation was evident between IgM-RF and erosions of the +RA cohort (Pearson's correlation coefficient;  $P < 0.05$ ). A significant inverse correlation was demonstrated between IgG-RF and erosions in the -RF cohort (Pearson's correlation coefficient,  $P < 0.01$ ). Proportions of +RF patients with nodules and erosions were significantly higher than their negative counterparts (Chi-square test;  $P < 0.05$ ). The proportion of individuals with positive family histories in the +RF cohort was significantly higher than the control cohorts (Chi-square test;  $P < 0.05$ ). A positive family history imposed a relative risk of 4.647 for developing +RF RA. A history of manual working enforced a

relative risk of 4.027 and 3.95 for developing +RF RA and -RF RA, respectively. The results of this study would contribute to fill the existing knowledge gap of RA in Sri Lanka.

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## 024/A

### Coconut fat intake and cardiovascular disease status –a cross sectional study

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The high saturated fat content in coconut has been positively implicated with high prevalence of cardio vascular disease (CVD). Current evidence shows that the chain length of fatty acids and types of fat have an important role in determining CVD risk. This cross sectional study examined the CVD risk factors (dietary and lifestyle) of a community consuming coconut as the major source of fat in their diet. Healthy 957 (males-340, females-617) volunteers aged 18 to 65 years were recruited from Gampaha district. The socio-demographic data, family history of disease and lifestyle factors were assessed using a pre-tested questionnaire. Anthropometry and arterial blood pressure were measured and Lipid profiles were determined. The nutrient intake was measured by three-day dietary records. The subjects were grouped as high fat group (>16 % energy from coconut fat (CF) daily) and low fat group ( $\leq$  16 % energy from CF). Associations between selected CVD risk factors and CF intake (as a dichotomous variable) were investigated. Associations were examined in a multivariate model adjusting for potential confounding variables (smoking, alcohol consumption, elevated blood pressure, BMI above cut-off levels). Average age of the population was  $42.7 \pm 11.9$  years. Mean total cholesterol levels (TC) ( $p=0.003$ ), Low-density lipoproteins (LDL) ( $p=0.001$ ) and total cholesterol to High-density lipoprotein (HDL) ratios ( $p=0.017$ ) were significantly higher among females compared with males. The mean CF intake of the population was  $32.5 \pm 14.4$  g/day, which represents  $68.3 \pm 16.6$  % and  $15.9 \pm 6.4$  % of the total fat and total energy intake respectively. There was no significant difference ( $p=0.001$  and  $p=0.005$ ) in CF intake between males and females. CF intake was not significantly associated with anthropometric risk factors (BMI > 25 kgm<sup>-2</sup>, waist to hip ratio; males >0.9 females >0.85), lipid profile (TC > 200 mg/dl, HDL < 40 mg/dl, LDL >150 mg/dl, Triglycerides >160 mg/dl) and blood sugar levels (>110 mg/dl) in univariate models, when applied to the total population. Similar observations were made in multivariate models adjusting for potential confounding factors. Consumption of CF an energy level of 16.4 % had no risk on the lipid profile of the study population.

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## 025/A

### Effect of selected traditional breakfast meals on postprandial serum glucose levels

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The glycaemic Index (GI), an index that reflects the potential of a carbohydrate food to raise the postprandial serum glucose level has now been accepted by the WHO as a tool for management of type II diabetes. Low GI foods have a beneficial health impact on individuals suffering from diabetes, cardiovascular diseases, obesity and cancers, most of which show a high incidence in Sri Lanka. Studies have reported that dietary fiber, fat and protein can lower the GI values of foods. The objective of the study was to calculate the GI values and investigate the effect of other nutrients on the GI values of some of the high moisture-breakfast meals consumed in Sri Lanka. The meals consisted of legumes (chickpea, mungbean, cowpea), Olu-milk rice and breadfruit. The GI values were determined with healthy individuals (n=10, age 20-30 yr) in a random crossover study design. The control (Prima crust-top white bread) and the test foods were served on separate occasions after an overnight fast (10-12 hrs). The 25 g digestible carbohydrate portions of the control (white bread) and test foods were served (chickpea, mungbean, cowpea, breadfruit and Olu-milk rice). The 25 g digestible carbohydrate content was arrived due to the high moisture percentage of the test food portions. The test foods were served with coconut scrapings or *lunumirisa* except for chickpea. The calculated GI values increased in the order of chickpea (boiled and tempered) < cowpea (boiled) < mungbean (boiled) < breadfruit (boiled) < Olu-milk rice (GI values  $\pm$  SEM were 29 $\pm$ 5, 49 $\pm$ 8, 57 $\pm$ 6, 64 $\pm$ 7 and 91 $\pm$ 8 respectively). A high negative correlation (r -0.918 p<0.05) between GI and total dietary fiber (TDF) per meal was observed for these 5 foods. Thus the lowering of GI of legumes could be attributed to high TDF contents (24.3 – 28.8 % DW). Such a correlation between GI and the fat or protein was not seen. However, when Olu-milk rice was omitted (with rather a high fat content 31.5% D.W), a significant negative correlation (r -0.984 p<0.05) was seen. Thus in the case of Olu-milk rice rather than the nutrient content some other factor may be contributing for the high GI. In conclusion, the legumes can be categorized as low GI foods (GI < 60) whilst breadfruit as a medium GI food (60 >GI<85) and Olu-milk rice as a high GI food (GI >85).

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## 026/A

### **A Comparative study of the antibacterial activity of crude extracts of *Munronia pinnata* and *Andrographis paniculata* against *E. coli***

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A Comparative study of the antibacterial activity of crude extracts of *Munronia pinnata* and *Andrographis paniculata* against *E. coli*. *Munronia pinnata* (family - Meliaceae) and *Andrographis paniculata* (family - Acanthaceae), are used in ayurvedic and traditional medicine in Sri Lanka for the treatment of fever, dysentery and skin diseases as a substitute for *Swertia chiratta* (Family Gentianaceae). It has been used by the traditional physicians as a substitute for *Swertia chirata* during the preparation of *Sudarshana curna* and *Daruparpatadi kwatha* too. It is recorded in literature that the alcoholic extract of *A. paniculata* exhibits significant antibacterial activity against *E. coli*. Both *S. chirata* and *A. paniculata* also possess anti bacterial activity and both species are used for the treatment of dysentery. Currently, *M. pinnata* is also used for this purpose as a substitute for *S. chirata* by traditional and ayurvedic physicians, though it was not mentioned in the ancient treaties. Thus, the activity of cride water and ethanolic extracts of *M. pinnata* and *A. paniculata* against *E. coli* were determined by the use of the filter paper disc method. The aim of this study was to verify the

antibacterial potentials of *M.pinnata* and *A. paniculata* using *E. coli* as the bacterial model. Chlorumpenicol 0.01mg/l was used as a standard antibacterial drug. A loopful of *E. coli* culture was inoculated in a 5.0ml of sterilized nutrient broth and allowed to grow at 40 °C for 24 hours. Aqueous and ethanolic extracts of both plants were tested with *E. coli*. The water extracts of both plants were prepared using 60.0g of dried coarse powder boiled with 1920.0ml of water, down to a volume of 240.0ml and further concentrated to 80.0ml in earthen pots under low flame.(as done in the preparation of a conventional decoction). They were then further concentrated to 40.0ml on water bath. For ethanolic extract 5.0g of coarse powder was extracted using a soxhlet apparatus. The extract was further concentrated at 30°C by Rota-vapor until a syrupy liquid was obtained. Two dilutions ( $10^{-1}$ ,  $10^{-2}$ ) were prepared and sterilized filter paper discs (3.0mm diameters) were wetted with 0.1 ml of each extract and placed on seeded (*E. coli*) agar plates. Four discs of different concentrations were placed on seeded agar plates in replicates and incubated at 40 °C for 48 hours. Growth free area around the filter paper discs were measured after incubation. According to the results traditional decoction concentration of *A. paniculata* showed the highest inhibition towards to *E. coli*. While the same concentration of *M. pinnata* showed a comparatively lower inhibition of *E. coli* growth than that of *A. paniculata*.

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## 027/A

### Studies of serum carotenoids and vitamin A of some hypercarotenemic children in Sri Lanka

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Long-term consumption of very high levels of absorbable carotenoids shows yellowing of palms, soles and other parts of the body. In Sri Lanka the main reason is over-consumption of papaw, carrot and pumpkin. A study was carried out to determine the serum carotenoid profile of hypercarotenemic subjects. Their sera were yellow in colour compared to the sera of the control subjects. The serum of hypercarotenemic patients (n=8) was examined by high performance liquid chromatography (HPLC) technique for carotenoids and vitamin A. In six of the cases a common profile was shown with  $\beta$ -carotene (9.9 - 35.7  $\mu\text{g/dL}$ ),  $\beta$ -cryptoxanthin and mono hydroxy metabolites collectively (5.3 - 48.5  $\mu\text{g/dL}$ ) and 6-8 metabolites (22.5 - 282.1  $\mu\text{g/dL}$ ) corresponding to di, tri and poly hydroxy derivatives of the  $\beta$  ionine ring. These metabolites were deduced from past studies done abroad. In all these cases vitamin A levels were within normal range (32 - 61  $\mu\text{g/dL}$ ). The other two cases were abnormal. One showed low  $\beta$ -carotene (3.5  $\mu\text{g/dL}$ ) and no  $\beta$ -cryptoxanthin and mono hydroxy metabolites but normal di, tri and poly hydroxy metabolites (128.2  $\mu\text{g/dL}$ ). This could be interpreted as being due to the high carotenoid diet being discontinued for sometime before venesection. However, vitamin A level was high (75.2  $\mu\text{g/dL}$ ) but still lower than upper level of normal (81  $\mu\text{g/dL}$ ). The other case showed high  $\beta$ -carotene (212.3  $\mu\text{g/dL}$ ) and  $\beta$ -cryptoxanthin (49.3  $\mu\text{g/dL}$ ) but no other normal mono, di, tri and poly hydroxy metabolites. Instead there was a more hydrophobic metabolite (343.9  $\mu\text{g/dL}$ ) than  $\beta$ -cryptoxanthin, which according to results cannot be further metabolized. This is probably due to formation of a metabolite that is not recognized by liver enzymes for further hydroxylation and subsequent excretion. In all cases hypercarotenemia was observed only after prolonged consumption of mainly papaw and carrot and less frequently pumpkin, whose metabolites cannot be clearly recognized as lutein overlaps with di-hydroxy metabolites. In view of the above results, parents should

be advised against over feeding with carotenoid rich foods, as this can lead to conditions that can be potentially more complicated than typical hypercarotenemia. Atypical hypercarotenemia is a function of the subject. It does not vary with carotenoids as all absorbable carotenoids of carrot, papaw and pumpkin have the same catabolic pathway.

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**028/A**

**Effect of different processing methods on starch structure: A microscopic study**

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Starch is crystalline in its native state. When heated in the presence of water, starch gelatinizes. This may result in the increase of the GI values of foods prepared by using wet heat. According to a previous study the dry heat processed meals showed significantly low GI ( $\pm$ SEM) values (wheat roti:  $72\pm 6$ , rice flour roti:  $69\pm 7$ , kurakkan roti:  $70\pm 8$  and atta roti:  $67\pm 9$ ) than that of wet heat processed meals (wheat pittu:  $101\pm 9$ , rice flour pittu:  $103\pm 7$ , kurakkan pittu:  $84\pm 6$  and hoppers:  $120\pm 8$ ). Thus the objective of this study was to investigate the effect of different processing on the degree of starch gelatinization and to correlate to the GI of the said foods. Roti (4 types) were cooked (dry heat) with coconut scrapings and flour (wheat only, wheat and rice- 1:1 w/w, wheat and kurakkan- 2:3 w/w or atta only) at 1:1 w/w. Pittu (3 types) was prepared (wet heat) with coconut scrapings and flour (wheat, rice or kurakkan) at 1:1 w/w. Hoppers was made using rice flour and the first extraction of coconut milk (10 h incubation). The isolated starch from foods was examined under the light microscope (x400 or x100) and the lengths and breadths of mature starch granules (n=10) measured.

Table 1. Percentage increase in the sizes of dry heat and wet heat processed starch granules compared to the corresponding raw flour starch granules

	Wheat starch		Rice starch		Kurakkan starch		Atta starch	
	Length	Breadth	Length	Breadth	Length	Breadth	Length	Breadth
<b>Dry heat</b>								
Wheat roti	35	30	-	-	-	-	-	-
Rice flour roti	25	26	>100	88	-	-	-	-
Kurakkan roti	31	31	-	-	>100	>200	-	-
Atta roti	-	-	-	-	-	-	30	27
<b>Wet heat</b>								
Wheat pittu	48	49	-	-	-	-	-	-
Rice flour pittu	-	-	DI	DI	-	-	-	-
Kurakkan pittu	-	-	-	-	DI	DI	-	-
Hoppers	-	-	DI	DI	-	-	-	-

DI – disintegrated

The increase in the lengths and breadths of starch granules compared to raw starch in wheat roti was significantly lower than that of wheat pittu ( $p < 0.05$ ). The light microscopic study revealed that the degree of swelling and disintegration of starch granules in pittu & hoppers were higher than that of

roti. Thus the reason for the significantly low GI values of roti compared to pittu and hoppers can be attributed to less disintegrated and swelled starch granular structure. This shows that the wet heat processing gelatinizes starch granules to a greater extent than that of dry heat processing. This correlates with the findings that foods processed using wet heat having higher GI values.

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**029/A**

### **Gastroprotective activity of *Trichosanthes cucumerina* aerial parts**

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*Trichosanthes cucumerina* Linn. (Family: Cucurbitaceae), locally known as Dummella is commonly found in Asian countries including Sri Lanka. The aerial parts of *T. cucumerina* are widely used in combination with other plants in the traditional medicinal systems as a remedy for fever, dropsy, acute bronchitis, boils, inflammation, skin diseases, jaundice, diabetes and gastric lesions. The aim of the present study was to scientifically investigate whether *Trichosanthes cucumerina* (T.C.) has gastroprotective activity. The oral gastroprotective effect of hot water extract (HWE) of T.C. aerial parts was evaluated by determining its ability to protect against gastric lesions in rats induced by absolute ethanol (5 mL/kg) or indomethacin (5 mg/kg). All the experiments were conducted using Wistar strain rats (weight: 200 – 220 g). The food was withdrawn for 36 h and water for 12 h in rats, before the commencement of the experiment. These rats were randomly divided into 5 groups (n = 8 rats/group; 3 males + 3 females) and groups 1 – 3 were orally administered with HWE at a dose of 375, 500 and 750 mg/kg, respectively. Group 4 was orally treated with equal volume of distilled water (1 mL; control) while group 5 was orally treated with the reference drug, cimetidine (100 mg/kg). In the indomethacin experiment, only one dose of HWE (750 mg/kg) was tested, as this was found to have the maximum effect in the alcohol model. Results show that the HWE of T.C. possess significant ( $P \leq 0.05$ ) and dose dependent gastroprotective effects in the alcohol model in terms of the length and number of gastric lesions mediated by alcohol, with a maximum effect at 750 mg/kg. A significant ( $P \leq 0.05$ ) gastroprotective activity was also observed in the indomethacin model. In the ethanol model, the protective effect demonstrated by the HWE of T.C was comparable with that produced by cimetidine. However, a significantly higher gastroprotective activity was observed in the ethanol model than in the indomethacin model. The HWE significantly increased the amount of mucus produced by the rat gastro mucosa (by 39%) and reduced the gastric acidity (by 36 %). pH of the gastric juice increased from 4.1 to 6.02. However, no change in the volume of gastric juice was observed. It may be concluded that HWE of T.C can exert a significant protection against ethanol or indomethacin induced gastric damage. Increasing the protective mucus layer and decreasing the acidity of the gastric juice are probable mechanisms by which the HWE of T.C. mediates its gastroprotective actions.

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## SECTION B

101/B

### **Performance of slicing cucumber in a newly formulated hydroponics solution**

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Hydroponics is the term used to describe growing plants without soil. Slicing cucumber (*Cucumis sativus*) is one of the most important market vegetables in the tropics. The performance of slicing cucumber, variety CANSAS, in newly formulated hydroponics solution compared to the commercially available Albert's solution was conducted under protected house condition. The new solution was developed considering the nutrient requirement of the slicing cucumber plant and it was characterized using computer aided chemical speciation modeling.

Two treatments with 30 replicates were kept at completely randomized design. During the study period environment parameters (temperature, relative humidity, light intensity both inside and out side the protected house - 4 times a day), plant parameters (plant height, number of leaves, number of flowers, number of fruits yielded), fruit quality parameters (dry matter, protein, ash, fat, vitamin), post harvest duration of fruits and solution parameters (solution consumption, EC and pH) were analyzed and recorded.

The result revealed that the slicing cucumber variety CANSAS can successfully be grown in Kamburupitiya area under protected house conditions hydroponically. Performance of plants with respect to plant height and number of leaves had no significant difference but number of female flowers, fruits per plant and the total yield were higher significantly in newly formulated solution. Average weight of fruits, as due to higher total consumption of the solution by the plants, was higher in products from Albert's solution but quality parameter of fruits, such as, dry matter (5%), ash (4%), fat (84%) and protein (5.5%) were higher in fruits harvested from the new solution. Shelf life was 33.3% higher in fruits harvested from the new solution. Further, no precipitation of metals was observed in the new solution during the crop cycle.

Acknowledgement: CARP

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102/B

### ***In vitro* multiple shoot and root induction of *Zeuxine flava* (Sandaraja)**

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*Zeuxine flava* (Sandaraja) is an important medicinal plant in Ayurvedic medicine system of Sri Lanka. It is being used for treatment of snakebites. This plant is listed under threatened category in 1999 List of threatened flora and fauna (Red list). Vegetative propagation methods have limited success and pod development frequency is very low. However seed germination under natural conditions have

never been observed. Therefore it is important to develop a micro propagation protocol for mass propagation of this important medicinal plant.

Apical meristems and nodal segment explants were tested for induction of shoots *in vitro*. Explants were surface sterilized using 10% Clorox (Sodium hypochlorite 5.25% v/v) and 70% alcohol each followed by three successive washings in sterile distilled water. Three different basal media – WPM, MS and KC were used with different concentrations of BAP, IAA and 2,4-D. WPM containing 2.25 mg/L BAP and 1.0 mg/L 2,4-D induced shoot buds from both axillary and apical buds after six weeks of incubation under 16h and 8hr dark photoperiod at  $25\pm 1^{\circ}\text{C}$ . None of the other tested media induced buds from explants. When concentrations of the basal medium were lowered to 1/2, 1/5, and 1/10, time taken for bud induction was reduced.

Elongated shoots were transferred into MS medium-supplemented 0.1 mg/L NAA, 1.0 mg/L BAP and 1.0 mg/L kinetin. Within four weeks, axillary buds of *in vitro* produced shoots started to initiate. Explants, which were maintained in, shoot induction medium, after 8 subcultures were able to produce root nodules as well as hairy roots without multiple shoots. When elongated shoots were transferred into MS medium supplemented with 0.1 mg/L NAA, 1.0 mg/L BAP and 1.0 mg/L kinetin root nodules were formed. However when elongated shoots were transferred into shoot induction medium during 4 weeks of incubation they were able to produce root nodules.

According to the results obtained 1/10 WPM medium supplemented with 2.25 mg/L BAP and 1.0 mg/L 2,4-D was the best medium for bud induction. However MS medium supplemented with 0.1 mg/L NAA, 1.0 mg/L BAP and 1.0 mg/L kinetin was the most suitable medium for multiple shoot induction. 1/10 WPM medium supplemented with 2.25 mg/L BAP and 1.0 mg/L 2,4-D found to be the best medium for root induction

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## 103/B

### **Effect of different organic manures on phosphorus availability in reddish brown earth soils**

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Phosphorus fixation is one of the major problems observed in fertilizer management practices in Reddish Brown Earth (RBE) soils. There is an opinion that the incorporation of organic manure with the P fertilizers may reduce the P fixation and increases the P use efficiency by plants. Therefore the objective of this study was to investigate the P availability in RBE soil during 2 months of period after incorporation of inorganic P fertilizer with different organic manures.

This study involved both incubation and uptake experiments. In the incubation experiment, five different organic manures namely compost, rice straw, gliricidia, poultry manure, and cattle manure were incorporated at the rates of 0 (control) and 15 t ha<sup>-1</sup> (wt/wt) for 200g of air dried soil samples. Then Triple Super Phosphate (TSP) was uniformly mixed with each soil sample at the rate of 0.5 g kg<sup>-1</sup> and incubated at room temperature. Sampling was done at one week intervals to measure the changes of Olsen P and soil pH. The uptake experiment was conducted by using same treatments for maize plants to determine P uptake and total dry matter production.

Results of the incubation experiment revealed that the available P has been decreased in all treatments during incubation period. However available P in poultry manure incorporated treatment was significantly higher than all the other treatments from second week to the end of the incubation period. It was also observed from uptake experiment that there was a significant difference in P uptake and dry matter production between poultry manure incorporated treatment and all the other treatments. Therefore the results of the study conclude that poultry manure may reduce the fixation of P in RBE soil. However to confirm the results further long term investigations are required.

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## 104/B

### **The possibility of substituting chemical fertilizer by organic manure in cattle – coconut integrated system**

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Cattle integration with coconut can replace some amount of chemical fertilizer applied to coconut with dung and urine. The paper describes how much of fertilizer can be replaced by organic manure and the cost reduction in fertilizing coconut.

Cattle were employed into two treatments;

T1 - Cattle fed with natural herbage

T2 - Cattle fed with natural herbage + tree fodder (*Gliricidia*) + low cost concentrate ( "Gava Thripasha" which contains rice bran - 30 %, molasses - 40 %, urea - 10 %, mineral mixture - 8 %)

Dung patches of 6 cattle (3 cattle from each treatment) were counted and weighed randomly for 9 days for the estimation. It is estimated that each coconut palm received 141 kg of fresh dung / year in T1 and 146 kg / year in T2 along with 66.6 kg of urine / year in T1 and 69.6 kg / year in T2. (13 cattle / ha; under tethering system) Cattle's rope was shortened up to 2 m at night to allow more dung and urine to be collected into the manure circle as they defecate 66 % and urinate 76 % at night. The dung and urine could replace Nitrogen fertilizer and Phosphorus fertilizer totally. Also it could reduce the Potassium fertilizer (MOP) applied to coconut by 84.56 % in T1 and by 88 % in T2 while Magnesium fertilizer (Dolomite) applied by 85.4 % in T1 and by 88.5 % in T2. This substitution can reduce the cost of fertilizing coconut by 85.77 % in T1 and by 88.92 % in T2. There's no significant difference between T1 and T2 as expected.

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## 105/B

### **Assessment of metal (Pb<sup>2+</sup>) stress recovery of *Spirulina platensis*, an edible cyanobacterium**

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*Spirulina platensis* is a well known source of protein comprising all the essential amino acids. As metal toxicity is becoming a matter of great concern, the present study focused on the metal stress

recovery of *S. platensis*. The species was grown in Zarrouk liquid medium adjusted to pH 7.0 at 25 °C. At the exponential growth phase, algal mass was harvested and resuspended in fresh medium to be used in metal treatments. Algal suspensions were treated with various initial Pb<sup>2+</sup> concentrations (1, 5, 10, 25 and 50 µg/mL) and incubated for 10 days. The algal cells without Pb<sup>2+</sup> in the medium served as the control. The growth was monitored by measuring the optical density at 560 nm. At day 10, the algal cells were separated, washed and resuspended in fresh Zarrouk medium (free from Pb<sup>2+</sup>) to assess metal stress recovery. Experiments were conducted in triplicate and repeated twice to confirm the reproducibility of the results.

Exogenous addition of lead showed varying toxicity to *S. platensis*. At a low concentration (1 µg/mL), Pb<sup>2+</sup> positively influenced the growth by 2.6 %. However, at higher concentrations, the growth was adversely affected and the extent of toxicity increased with increasing Pb<sup>2+</sup> concentration in the medium. The inhibitions at 10 d were 5, 40, 49 and 78 % respectively for 5, 10, 25 and 50 µg/mL of Pb<sup>2+</sup>. Once introduced to the Pb<sup>2+</sup> free medium, all the cultures were found to grow well irrespective of the severity of the initial stress. However, cultures treated with high concentrations of Pb<sup>2+</sup> were slow to recover from the transferring shock. Results could be concluded that *S. platensis* is quick to recover from the initial metal stress.

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**106/B**

#### **Effect of different mixtures of vermicompost and coir dust on soil microbial activity**

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Vermicompost is a nutrient-rich, natural fertilizer and soil conditioner. Coir dust, on the other hand, is a widely used component in potting media, despite its poor nutrient contents. A mixture of these two ingredients could thus provide a better growing media for plants. The present laboratory study was undertaken to assess the effect of different mixtures of vermicompost and coir dust on soil microbial activity as measured by carbon mineralization.

Four different vermicompost and coir dust mixtures [100 % vermicompost (T<sub>1</sub>), 75 % vermicompost : 25 % coir dust (T<sub>2</sub>), 50 % vermicompost : 50 % coir dust (T<sub>3</sub>) and 25 % vermicompost : 75 % coir dust (T<sub>4</sub>)] were applied to the soil. The control soil was free from vermicompost and coir dust (T<sub>5</sub>). A Completely Randomized Design (CRD) was used in the experiment with four replicates. Carbon mineralization was determined at 3, 7, 14, 21, 28, 35, 42, 49, 56, 63 and 70 days after the treatments. Data were statistically analyzed using SAS package.

Results at day three showed no significant ( $P \leq 0.05$ ) variation among the treatments. However, treatments T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were significantly ( $P \leq 0.05$ ) different from the control at day 7 and treatments T<sub>2</sub> and T<sub>3</sub> were significantly ( $P \leq 0.05$ ) different at day 14. Since then, significant ( $P \leq 0.05$ ) differences were no longer observed for any treatment until the end of the incubation. In contrast, treatment T<sub>2</sub> exhibited higher carbon mineralization than any other treatment throughout the incubation. Results could therefore be concluded that T<sub>2</sub> was proved to be the best mixture to enhance the microbial activity.

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107/B

### Flower Infesting Thrips and Their Plant Hosts

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Thrips (Insecta:Thysanoptera) on plants may infest different parts of a plant or confine themselves to flowers. Thrips on flowers cause scarring, browning and withering. Such damage in export horticultural crops in particular causes economic losses. Many flower living thrips act as pollinators. Very little is known in Sri Lanka of thrips on flowers. The objective of this study was to record flower-infesting thrips and their plant hosts. Thrips on flowers were collected from agricultural, horticultural, floricultural, natural vegetation and weeds in 15 locations in 8 districts; with emphasis on export floriculture and ornamental flowers. Slide mounted specimens were identified using keys descriptions and help from experts.

Twenty four morphospecies of thrips belong to 2 families and 2 subfamilies were collected. Of them, 17 (in 7 genera) were identified to species level, 2 up to generic level and 5 up to subfamily level. Flower infesting thrips were recorded from 153 plant species in 105 genera and 42 families that comprised vegetable crops, fruit crops, weeds, lianas, horticultural plants, large trees, herbs, shrubs etc. Of the identified species, *Thrips orientalis*, *T. subdunula* & *T. paravispinus* have not been previously recorded from Sri Lanka. *Haplothrips gowdeyi* was the most common species occurring in 36 plant species belonging 9 families followed by *Thrips hawaiiensis* on 25 plant species in 15 families. Majority of the thrips were generalists. Only 2 species were host family specific. Thus, *Microcephalothrips abdominalis* was confined to family Asteraceae and *Megalurothrips usiatus* to family Fabaceae. Although majority of the thrips were confined to flowers, *Thrips palmi* and *Scirtothrips dorsalis* were present on leaves and shoots of host plants as well. Five thrips species known to be viral vectors worldwide were recorded from flowers. Chilly infested with *Scirtothrips dorsalis*, *Frankinella scultzi* and *Thrips palmi* showed symptoms of leaf curl disease. Withering of flowers, browning of petals and scarring of petals were observed occasionally in few of the thrips infested flowers. From export flowers 5 thrips species were recorded that are known to occur world over. Thrips recorded had a wide distribution except *Thrips flavus* that was confined to the Nuwara Eliya district and the Knuckles forest range. On certain occasions, more than one species of thrips was found on the same flower. Thus, of the 153 flower species, 39 had more than one thrips species infesting its flowers.

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108/B

### Assessment of weed species as floral resource providers for parasitoids and other insects

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Provision or promotion of floral resources is an accepted practice to conserve parasitoids in agricultural lands as a strategy of biological control of insect pests. Weeds in farmlands are one of the good floral resources for parasitoids, but not all the weeds are suitable in this purpose. Hence, the objective of this study is to identify the weed species that provide floral resources to parasitoids and other common insects.

Sixty different weed species belonging to 18 families were surveyed around Peradeniya in agricultural lands and in University Park area. The insects visiting flowers were sampled using sweep nets around 10.00 am in sunny days. Collected insects were processed and separated into taxa. In addition, insects visiting ten weed species were sampled through out the day at hourly interval. Morphology of flowers and parasitoids were examined microscopically to examine possible relationships.

The total number of insects sampled from each weed species varied significantly among weeds. The highest is 95 insects per sample that was collected on *Euphorbia heterophylla* while the least number, 12, was collected on *Tephrosia purpurea*. Of the insects visited weeds, 60% was dipterans and 24% was hymenopterans. The average number of insects collected per family per plant significantly varied among families. Family Verbenaceae attracted 9.6% of dipterans and hymenopterans while Families Euphorbiaceae, Convolvulaceae, Oxalidaceae, and Malvaceae attracted 8.5, 8.2, 7.8, and 7% of hymenopterans and dipterans respectively. The hymenopterans which includes parasitoids and bees, heavily visited some weed species: *Commelina benghalensis*, *Thunbergia alata*, *Argyraea populifolia*, and *Abutilon indica*. Of those hymenopterans, 57, 43, 37, and 37% were parasitoids. In contrast, certain weed species had low (<10%) numbers of hymenopteran visitors: *Polygonum chinensis*, *Cassia tora*, *Solanum nigrum* and *Oxalis latifolia*. Hymenopterans collected from weed species that had higher percent of visitors mainly belong to three families: Braconidae, Ichneumonidae and Eulophidae. Of the insects collected throughout the day, 71% of parasitoids visited in the morning. This trend was common for all the weed species sampled. The total number of parasitoids visited weeds was positively correlated with corolla depth ( $R^2=82\%$ ), diameter of upper ( $R^2=77\%$ ) and lower ( $R^2=89\%$ ) rim of corolla. The weeds around farmlands contribute for the survival of insects including the parasitoids. Weed species beneficial for parasitoids could be promoted as a measure of conservation of parasitoids.

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## 109/B

### Effect of some insecticides on the nymphal parasitoid of whitefly (*Bemisia tabaci*) in brinjal

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This study was conducted to evaluate the effect of four different insecticides viz. acetamiprid, imidachloprid, deltamethrin and dimethoate on the associated parasitoids of *Bemisia tabaci* in brinjal at the Agronomy farm, Eastern University, Sri Lanka. Insecticides were sprayed twice at 14 days interval during the experimental period. The percentage of parasitized whitefly nymphs was monitored at weekly intervals from a day prior to spraying to 14 days after second spraying. The percentage of parasitized whitefly nymphs was calculated by multiplying the ratio of number of emerged parasitoids per sample: number of whitefly nymphs per sample by 100. Statistical analysis was limited to the post-spray sampling dates.

*Encarsia cibcensis* Lopez Avila and *Eretmocerus californicus* were the two primary species of parasitoids found attacking *Bemisia tabaci* at the research site. There were significant ( $P < 0.05$ ) differences in the averaged (over the post-spray sampling dates) percentage parasitism of whitefly nymphs between treatments. Highest rate of parasitism (49.85%) being observed in the acetamiprid treatment followed by control (49.27%), imidachloprid (39.8%), dimethoate (28.48 %) and deltamethrin (18.85%). The percentage parasitism was significantly ( $P < 0.05$ ) low in both deltamethrin and dimethoate treatments compared with the control. Therefore both dimethoate and deltamethrin were not suitable to use as selective insecticides against *Bemisia tabaci* without affecting the parasitoids relative to control. But, both acetamiprid and imidachloprid treatments did not show any significant difference ( $P > 0.05$ ) with control in the recorded percentage parasitism. Even though the imidachloprid treatment did not show any significant difference with the control in the recorded percentage parasitism it also show no significant difference ( $P > 0.05$ ) with dimethoate treatment. Based on these results, concluded that the acetamiprid had the minimal effect on the activity of parasitoids, especially relative to other three tested insecticides.

The results of this study suggested that acetamiprid could be used as a selective insecticide against *Bemisia tabaci* in brinjal with minimal effect on the associated parasitoids such as *Encarsia cibcensis* Lopez Avila and *Eretmocerus californicus*. Therefore it has the potential to improve the compatibility between chemical and biological control, especially relative to imidachloprid, dimethoate and deltamethrin.

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**110/B**

### **Pests requiring plant quarantine attention during importation of olive (*Olea europaea*) seeds**

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A proposal to import olive seeds prompted us to analyze the risk to determine the pests that require plant quarantine attention. According to the international standards developed by the International Plant Protection Convention (IPPC), occurrence of the pests in Sri Lanka, their potential of entry, their potential of establishment and their economic impact were considered in this Import Risk Analysis (IRA). Out of eleven pests that can be transmitted by olive seeds, an insect *Cryptophlebia leucotreta*, a fungus *Verticillium dahliae* and two viruses, Cherry leaf roll virus and Olive latent ring spot virus require plant quarantine attention during the importation of olive seeds. Therefore, safeguard measures should be implemented to prevent the entry of such pests into the country. Permission to import olive seeds may be granted under special conditions that the consignments should be free from *Cryptophlebia leucotreta*, *Verticillium dahliae*, Cherry leaf roll virus and Olive latent ring spot virus.

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**111/B**

### **Thin layer drying kinetics of Sri Lankan paddy varieties under low humid conditions**

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Rapid biological degradation of food under high humid conditions is a well known effect. The conditions of stored grains are determined by complex interactions between the grain and the macro and micro-environment, and a variety of organisms including micro-organisms, insects, mites etc. and their existence has direct link to the moisture content in grain. The objective of this study is to investigate the effects of environmental humidity on the drying of paddy. In addition to the characterization of locally produced paddy, important applications of the findings can be found in the design and construction of modern warehouses for storage of paddy.

Thin layer drying characteristics of paddy were examined within the relative humidity (RH) range from 30% to 60%. BG358 and BG359 pure line paddy collected from Rice Research and Development Institute, Bathalagoda, Ibbagamuwa, and a constructed prototype low humid chamber have been used for this study. The data of sample weight of paddy, ambient air temperature and RH of the drying air were recorded continuously during each test. Normalized drying data was transformed into dimensionless parameter called Moisture Ratio (MR), and fitted with different semi-theoretical models. The two-term model gave better predictions than the other models, and satisfactorily described the thin-layer drying characteristics of paddy. Diffusion coefficient of BG358 is found to vary from 0.0040 1/S to 0.0056 1/S, and BG359 from 0.0045 1/S to 0.0057 1/S. The effective diffusivity of BG358 varies from  $3.68 \times 10^{-10}$  m<sup>2</sup>/S to  $5.11 \times 10^{-10}$  m<sup>2</sup>/S and the effective diffusivity of BG359 varies from  $4.64 \times 10^{-10}$  m<sup>2</sup>/S to  $5.85 \times 10^{-10}$  m<sup>2</sup>/S over the RH range. RH dependence of the diffusivity coefficient can be described using the Arrhenius-type relationship.

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**112/B**

### **Development of biscuits using wheat-rice flour blends**

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Even though rice is the staple food in Sri Lanka, usage of rice flour into bakery industry is rare. Therefore, studies were undertaken to develop biscuits by incorporating rice flour since biscuits, cookies and crackers represent the largest category of snack items among the baked food in Sri Lanka.

While processing of paddy, a sizeable quantity of broken rice is produced which is an economic loss to the processors. It could be used for food purposes and the baked products offer a good avenue for its utilization.

Hence the objective of the study were, determine the critical limit of incorporation of rice flour into wheat flour in preparation of good quality biscuits and find out the best recipe from developed products.

For this, wheat flour was fortified with rice flour in varying proportions (w/w, 0, 10, 20, 30 and 40%) to develop a series of blends for biscuit preparation according to a standard recipe.

A sensory evaluation by a panel of 10 judges was conducted on 5-point hedonic scale in order to determine the critical limit of substitution of rice flour for wheat flour in good quality biscuit. Results of the sensory evaluation indicated that wheat flour could be substituted with rice flour up to 40% level, as a source of dietary fibre, without affecting the overall quality.

Analysis for proximate composition was conducted to estimate moisture (%), ash (%), fat (%), protein (%) and crude fibre (%). Moisture content of biscuits increased with increasing percentage of rice flour showing a significant difference between 40% rice substitution with control and 10% rice substitution. No significant difference in ash content was shown with increasing rice incorporation. Fat content is higher in 40% rice sample and significantly different from other biscuit samples. Protein content of biscuits showed positive relationship with increasing level of substitution of rice. Fibre content was significantly higher in 30% and 40% level of rice substitution.

Biscuit showed a good keeping quality over a period of three months.

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**113/B**

### **Microbial status of tea (*Camellia sinensis*) during different stages of processing in up country**

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A study was conducted at Tea Research Institute of Sri Lanka, Talawakelle to evaluate the microbiological variations of tea in different stages of processing. Quad replicate samples were taken from intact leaves, pre-withering, post-withering, pre-fermentation, post-fermentation, post-firing and from the made tea grades of BOP, BOPF, PEKOE and dust 1. Microorganisms were extracted from each sample using standard microbiological techniques and assessed the bacteria, moulds and yeast populations.

Bacteria contamination levels were very high at pre-withering ( $1.01 \times 10^7$  cfug<sup>-1</sup>) and pre-fermentation ( $7.3 \times 10^6$  cfug<sup>-1</sup>) steps. The level of bacterial colony counts at pre-withering was positively correlated ( $R^2=0.37$ ) with the final grades of tea. Yeast and moulds levels were very low up to post withering stage ( $8.48 \times 10^2$  cfug<sup>-1</sup> &  $1.1 \times 10^4$  cfug<sup>-1</sup> respectively) and very high during pre ( $4.08 \times 10^5$ ,  $1.2 \times 10^5$  cfug<sup>-1</sup>) and post-fermentation ( $5.3 \times 10^4$  cfug<sup>-1</sup>,  $8.7 \times 10^4$  cfug<sup>-1</sup>). The amount of yeast and moulds at pre and post-fermentation steps directly influenced the amounts in the final grades.

Firing of tea dhoos reduced all microbial populations significantly ( $P < 0.0001$ ) due to high temperature (88 °C - 91 °C) condition. Under these temperatures tea was not sterilized but only reduced the bacterial ( $6.7 \times 10^4$  cfug<sup>-1</sup>) and fungal ( $2.7 \times 10^2$  cfug<sup>-1</sup>) counts. Withering and fermentation steps were identified as the critical points where microbial contaminations take effect. The prominent

moulds found in samples were *Aspergillus spp*, *Penicillium spp*, *Pestalotia spp*, *Mucor*, *Fusarium*. Among these *Penicillium* and *Aspergillus* were found the most common.

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**114/B**

**Communal attitude towards waste management practices: A case study in Faculty of Agriculture, University of Ruhuna.**

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The reduction, reuse and recycling (3R) of institutional waste have been identified as the key components of waste management strategies throughout world. This paper explores the attitudes of a community of tertiary education institute. All possible parties such as academic staff, non academic staff, students and cleaning service personals were interviewed. Questionnaire survey and informal discussions were carried out to gather information regarding their attitude toward and the present status of the waste management practices of the faculty of Agriculture, University of Ruhuna. Majority of the faculty community agreed that there should be a balance between development and environmental pollution. Ninety six percent of respondents expressed that environmental pollution as a serious threat. Even after introduction of 20 microns polythene policy by the government, 31 % of the community used lunch sheets daily, and 29 % used in five days a week. If recyclables are available 77 % of the faculty community was ready to pay extra money for them and 68 % of them liked to pay up to 5 Rupees per sheet. Most of the faculty members (66 %) were unaware of the fate of waste produced by them in the faculty. Majority (89 %) of them were ready to cooperate or participate in future waste management plans of the faculty, indicating the potentials to implement a community based sustainable waste management system. (CBSWMS) Many believed that the current waste management system is not an effective enough. Strong awareness program is needed to develop and strengthen CBSWMS. Eighty one percent of respondents identified that the higher education lead by the community is most important strengthen for implementation of CBSWMS. It was concluded that CBSWMS could be successfully incorporated in to the community of a Tertiary education system.

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**115/B**

**Determination of the effects of environmental conditions on the survival of probiotic bifidobacteria in fermented milk and development of polynomial survival models**

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Bifidobacteria are used as probiotic bacteria in fermented milk products and are reported to have health benefits on humans if consumed in sufficient numbers. However, its survival in many probiotic foods is poor due to many environmental conditions, pH, storage temperature and oxidation reduction potential ( $E_h$ ) being the most important. Therefore, determination of the effects of these environmental conditions as well as development of mathematical models to describe the survival, are of importance to the food industry.

The effects of storage temperature, pH and  $E_h$  on the survival of *Bifidobacterium longu* were determined in a 3×4×3 factorial design using three storage temperatures (4, 8, 12°C), four pH (4.0, 4.25, 4.5, 4.75) and three  $E_h$  (0, 200, 400 mV) values. Experimental data were fitted to the Baranyi survival model using the software DMFit Ver 2.1 to generate survival curves. Analysis of variance (ANOVA) was performed using SAS Ver 8.0 in order to determine the single and combined effects of the environmental conditions on bifidobacteria. Polynomial multiple regression equations were calculated using Micromath Scientist Ver 1.05 to quantify the effects of environmental conditions on the survival of bifidobacteria and to generate the secondary polynomial survival model.

*B. longum* was susceptible to acidity and survival was log-linear at low pH values (pH 4.0, 4.25) whereas at high pH (pH 4.75) pronounced shouldering and tailing effects were apparent forming sigmoid survival curves. Both individual environmental conditions (T, pH,  $E_h$ ) as well as interactions between  $E_h$  and pH affected survival and death was always more rapid at low pH and high  $E_h$  values. Storage temperature, pH and  $E_h$  could be manipulated to enhance survival. Of the three,  $E_h$  reduction by addition of reducing agents appears to be the best way to enhance survival without adversely affecting other properties. The proposed polynomial survival model ( $T_{4D}=23.896+1.919*T+33.0104*pH-0.120*E_h-1.227*T*pH+0.00135*pH*E_h+0.00227*T*E_h+0.0175*T^2-1.564*pH^2+0.0000415*E_h^2$ ) is the first of its kind developed to describe the survival kinetics of bifidobacteria in fermented milk. Moreover, this study is the first to incorporate  $E_h$  in a modeling experiment on the survival of a bacterium. The proposed polynomial survival model can be used by the bio-yoghurt manufacturers in determining the shelf-life and the expiry date of their products.

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116/B

### Screening of systemic fungicides to control nutmeg leaf fall disease

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Nutmeg leaf fall disease is one of the major problems among nutmeg cultivators. This disease causes yield reduction as well as gradual death of the plant. Due to this serious condition, this study was carried out in the central research station of the department of export agriculture, Matale and some of selected farmer fields in central province of Sri Lanka. The causal organism of this disease has been identified as *colletotrichum* sp. Effectiveness of the systemic fungicides was tested in *in-vivo* and *in-vitro* conditions to control the causal organism of nutmeg leaf fall disease. In addition two fungicide application methods that are root application and stem application were evaluated to find out better application method. Although three fungicides could control the causal organism under *in-vitro* condition, only two chemicals were found effective for controlling pathogen in the *in-vivo* condition. According to the results, stem application of 7.5 ml of Tebuconozol gave 99% disease reduction. Root application of metalaxil and mancozeb also gave better results. However, this method needs increasing number of roots treated in order to prevent root death. Both treatments want to be repeated

at two weeks interval for three months. Continuous observation is needed even on recovered trees and the above treatments should be repeated if affected again.

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**117/B**

**Quick wilt disease of black pepper (*Piper nigrum* L.) in Sri Lanka: isolation of the causal organism by zoospore trapping onto black pepper leaves, its identification and screening *Piper* species against *Phytophthora capsici***

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During the recent past there was a controversy on the cause of the black pepper quick wilt pathogen in Sri Lanka and is due to either *Fusarium* spp or *Phytophthora* spp. This study confirmed the cause of the Quick wilt disease of black pepper (*Piper nigrum* L.) in Sri Lanka as *Phytophthora capsici*. The work conducted showed that isolation of *Phytophthora capsici* as a difficult task; most techniques attempted, i.e. direct isolation from infected plant material, baiting, soil dilutions etc. was failed. However, isolation of the causal organism by zoospore trapping onto black pepper leaves which were partially submerged in a quick wilt affected soil and water mixture found to be successful. The lesions obtained had fast growth. They were clear black in colour. The progressive margins of above lesions found to be the best for isolation of *Phytophthora*, the quick wilt pathogen.

The characteristic mycelia growth pattern, length/breadth ratio  $1.83 \pm 0.29$  and long sporangia stalks  $66.18 \pm 44.75 \mu\text{m}$  confirmed the isolated fungi as *Phytophthora capsici*. Besides, inoculation of detached semi matured leaves of different *Piper* species with the pure cultures of *Phytophthora capsici* showed no infection on *P. chuyva* and *P. longum* confirming that the above two *Piper* species are resistant against quick wilt pathogen. This result suggests the possibility of using *P. chuyva* root stocks to graft with high yielding black pepper cultivars. In future, this technique may consider in the quick wilt/collar rot control programme. Although *P. longum* showed some resistance, it may not be suitable as a root stock as the stem diameter is different when compared with cultivated black pepper.

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**118/B**

**Evaluation of fungicides and pesticides for the control of nursery pests and diseases of cinnamon (*Cinnamomum verum* Persl)**

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Most pests and diseases are economically damaged at nursery stage in cinnamon plants due to high density of plants and also high level of humidity prevailing in cinnamon fields. Main objectives of this experiment were to identify the most sever pests and diseases in cinnamon nursery, as well as their time of infection and to study the most suitable insecticides and fungicides for controlling there pests and diseases. Experiment was conducted at the cinnamon research station during the first six months

period of year 2006 and the experiment was repeated for another six months to obtain more accurate results. Five fungicides, Folicur (Tebuconazol), Tilt (Propiconazol), Shakthi (Hexaconazol), Copper based Champion and Bavistin (Carbendasim) with four insecticides Perfection (Dimethoate), Cyrun (Chlorpyrifos), Admire (Imidacloprid) and Rejent (Phenyl phyrasol) were used in this study. Poly bags were arranged into three replicates consisting 16 poly bags in each plot. Five plants were maintained in each poly bag and treatments were applied once per two weeks interval. Plant height, Number of leaves per plant, severity of leaf diseases, different kind of insect damages were recorded biweekly and calculated as an average per month. According to the experimental results, most severe disease in cinnamon nursery plants was leaf blight, while most severe pest attacks were leaf minor, mite leaf galls (lower leaf galls), leaf eating caterpillar and thrips damages. Up to one month from seed germination, leaf minor damage was significantly sever than the other pest damages. Among the five fungicides, leaf blight disease was significantly reduced by hexaconazol, tebuconazol and propiconazol. But tebuconazol and propiconazol were badly affected the plant height, as well as number of leaves per plant. Lower leaf gall damage was significantly reduced by dimethoate and chlorpyrifos. Leaf eating caterpillars' damage was significantly minimized by chlorpyrifos than the other insecticides. After considering collected results and environment impact, hexaconazol can be considered as the most suitable fungicide for control of leaf blight disease. Leaf galls, thrips damage and leaf minor damage can be minimized by using domethoate. Chlorpyrifos is suitable for controlling leaf eating caterpillar damage.

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## 119/B

### **The possibility to apply steam blanching method for pepper (*Piper nigrum* L.) processing**

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Vegetables, fruits and other fresh plant materials are heat blanched with water or steam for a short time will inactivate the enzymes and results in a better quality food. Blanching will also destroy surface microorganisms and reduce the initial infections. The food will also shrink slightly for increase storing period. The blanching technique gives more advantage in black pepper processing which is called as 'hot water treatment' in the pepper industry and had recommended to practice. Usually fresh pepper soaks in 98°C of hot water for two minutes and expects a good appearance with uniform blackish colour. In addition to that blanched pepper helps to reduce the duration of drying time. The aim of this study was to apply steam blanching techniques for pepper and find out the possibility of success and suitable time period for steam.

First step of the experiment was done to find out the possibility of applying steam blanching technique for pepper and to detect the suitable rang of time for steam. Pepper blancher was renovated to use as a steam blancher. Twenty five kg of green pepper samples were cleaned and subjected to the treatments numbered as 1-6, respectively as hot water treatment for 2 min (standard method for pepper balancing), steamed for 5min, 10min, 15min and 20min. treatment no. one was used as the control. Final physical quality attributes such as overall appearance, colour were considered to compare the treatment performances with the control and selected a suitable time range for pepper steam blanch was 10-15 min.

The second step was to determine the appropriate time of steam without affect to the both physical and chemical quality of pepper. The five treatments were chosen and numbered as 1-5. Treatment no. one was the control, which was same to the step 01. Rest of the treatments were the steamed for

10min, 12min, 14min and 16min. The same physical quality as step 01 and oil content of the treated black pepper samples were got concerned to compare with the control. The most acceptable final product was given by the treatment no. 03. The product was totally uniform blackish colour and an attractive appearance was presented which was same as to the pepper obtained by the control or hot water treated sample. There was no big effect of steaming for 12min on oil content when compared to the oil percentage of the treatment no. 03 (3.49 %) with the control sample (3.19 %). The steam blanching method can be applied for the blanching of pepper without any considerable change of the physical and chemical quality attributes of black pepper. The time of steaming should be 12 min to get good quality black pepper, which is same as to the hot water, treated black pepper.

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## 120/B

### Impact of stage of maturity on chemical changes of nutmeg (*Myristica fragrans* Houtt.)

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Nutmeg, *Myristica fragrans* Houtt. belongs to the family Myristicaceae, and is one of the most important export agricultural crops of Sri Lanka. A serious problem in the nutmeg industry is harvesting at immature stages for the market. This affects the changes in chemical compositions, yield and the quality of nutmeg, which has clearly defined.

Fruits were labelled at the time of initiation and harvested at 1 month intervals from 4<sup>th</sup> month of fruit set up to 8 months. The experiment was set according to the Completely Randomized Design (CRD) with 9 replicates for each age group. Chemical characteristics (oil content, oleoresin content of seed and mace, changes in chemical constituents of seed and mace oils) were determined.

Mean oil contents were 20 % and 9 % respectively in mace and seed at 4 months and significantly decreased at P=0.0001 with maturity (2.5 % and 1.5 % in mace and seed in 8 month old fruits). The highest oleoresin contents 48 % and 27 % were recorded in the 5 month old fruits and gradually reduced up to 19 % and 15 % respectively in mace and seed in 8 month old fruits. Elemicin and myristicin are two major compounds. The concentration changes of other 8 chemical compounds were not significant with maturity. The concentration changes of elemicin and myristicin were as follows.

Table: Changes in elemicin and myristicin concentrations with age in seed and mace oils

Age	4 months		5 months		6 months		7 months		8 months	
	seed oil	mace oil	seed oil	mace oil	seed oil	mace oil	seed oil	mace oil	seed oil	mace oil
% elemicin concentration	12.71	15.86	19.82	14.63	12.47	12.61	10.41	9.20	10.19	8.91
% myristicin concentration	10.80	14.78	17.22	12.17	16.23	10.79	12.50	9.79	10.54	7.72

Due to low availability of extraction methods of oils and oleoresins at farmer level it is better to keep fruits until fully mature stage to earn a higher income as well as to supply a quality product to the market.

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121/B

### Evaluation of coffee selections and crosses for the yield in mid country intermediate zone, Sri Lanka

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Coffee is undoubtedly the most valued of the stimulant crop, which is a member of the family *Rubiaceae*. Among the several coffee species, commercially cultivating coffee species in Sri Lanka are arabica coffee (*Coffea arabica* L.) and robusta coffee (*Coffea canephora* Pierre). One of the major objectives of a crop improvement program is to produce a promising coffee variety, which is having better yield than the existing varieties. It is clear therefore, that further improvement in *C. arabica* and *C. canephora* will depend more on artificial hybridization among varieties that are genetically divergent, followed by selection with in progenies of subsequent generations of selfing.

The study was conducted at Research Station, Department of Export Agriculture, Matale in 1998. In this study, seedlings were raised from selected mother plants IMY 1, 2, 3, 4, 11, 12, 13, 14, 1-P-4, 1-P-6, S274, Q105, Q104, Q36, C2, S9, HDT, S6t and cross pollinated plants of GCR x GCR, S9 x S9, HDT x HDT, S7 x HDT, S9 x S7, S7 x S7. Completely Randomized Design (CRD) was used. The field was arranged into single plant plots. Other management practices were done according to the recommendations published by the Department. Growth performance of each variety was studied using growth parameters such as plant height, number of branches and spread of the canopy. Yield data (Fresh berry weight) were observed for six years of time period. Analysis was done using SAS software package.

When consider the yield data for six consecutive years, eight IMY plants ( IMY 44/1, 26/1, 42/3, 42/5, 45/1, 40/1, 11/1, 19/1) and five cross pollinated plants (GCR x GCR 6/3, S7 x S7 6/4, HDT x S7 15/2, HDT x S7 16/3, S9 x S9 10/3) can be selected based on their high yielding ability which the estimated dry yields ( over 2500 kg ha<sup>-1</sup> yr<sup>-1</sup> and 2200 kg ha<sup>-1</sup> yr<sup>-1</sup> respectively). The mean yield was low because of the alternative yearly bearing pattern. But, some of the selected IMY plants have showed yield more than 3.5 kg plant<sup>-1</sup> in dry basis (IMY 26/1 and IMY 44/1). Studying of growth data of above selected individual plants showed that it takes approximately 24 months to reach the top height of growth (150 cm). Even though, some plants contain small canopy and less number of branches they show higher yield because of high number of berries per plagiotrophic branch (IMY 26/1 and HDT x S7 16/3 ). IMY 44/1 gave the highest yield, though it showed comparatively slow growth. Highest yield may due to its wide canopy. Among the cross pollinated plants there is no significant difference in growth. Therefore, above characteristics are important for future breeding works such as hybridization.

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122/B

### Effect of chemical fertilizer on yield of cocoa (*Theobroma cacao* L.) at wet zone mid country 3b (WM-3b)

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National average of cocoa yield is around 332 Kg/ha/yr, though the potential yield is over 1000 Kg/ha/yr. One of the main reasons for the gap is poor management practices and out of that soil

fertility management is very often neglected. Therefore this experiment was conducted to study the N,P and K requirements of cocoa.

A field experiment was conducted at Export Agriculture Research Station, Matale in mid country wet zone-3b (WM-3b). Main fertilizer treatments consisted with two levels of N (100 and 150 g/plant/yr), two levels of P (50 and 75g/plant/yr) and three levels of K (60,120 and 180g/plant/yr). The experiment arranged in a Randomized Complete Block Design (RCBD) with three replicates and each plot consisted with nine plants.

According to the result response for applied Nitrogen varied from year to year. Response for Phosphorus was not prominent. But application of potassium caused to increase the cocoa yield. K treatments were significantly difference with control. But there was not significant difference between 120 g K<sub>2</sub>O and 180 g K<sub>2</sub>O . However result confirm that cocoa require a higher amount of K fertilizer. Based on the results it needs to increase current level of K<sub>2</sub>O/plant from 90g to 120g.

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## 123/B

### **Effect of different rates of Gliricidia green manure on the yield of Arabica Coffee.**

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Coffee is a popular beverage all over the world. In Sri Lanka, Robusta and Arabica coffee are the two important commercial species of coffee, cultivated in wet and intermediate zones. It is cultivated over an area of 15,000 ha in Sri Lanka. Though the potential yield under moderate management condition is over 1500 kg/ha/yr, the present average yield is around 332 kg/ha/yr. The major reason for this is poor soil fertility management due to high cost of inputs such as inorganic fertilizers. The objective of the study is to evaluate the possibilities of using Gliricidia as a source of green manure for Arabica coffee and to find out the most appropriate rate of Gliricidia as a green manure for Arabica coffee. The present investigation was carried out during the period of 2000-2006 at Export Agriculture Research station, Matale (7<sup>o</sup> 10'N, 80<sup>o</sup> 7'E 357 MSL) in mid country wet zone (WM<sub>3b</sub>) of Sri Lanka. Three different rates (10, 15 and 20 kg/ plant/ yr.) (wet basis) of Gliricidia green manure and a control with zero rate of Gliricidia were tested. Treatments were applied in 4 splits and treatments were replicated four times in randomized complete block design. Yield data was recorded for consecutive 4 years. Results showed that adding of Gliricidia 20 kg/plant/yr has been given the highest average yield of 4314 kg/ha/yr while Gliricidia 15 kg/plant/yr has given the second highest yield of 4044.8 kg/ha/yr. Annual average yield of 2948 kg/ha was reported with application of Gliricidia 10 kg/plant/yr while annual average yield of 993.2 kg/ha was reported with the control. Significant differences were reported with the control and the Gliricidia treatments. Since there is no significant difference between 15kg and 20kg of Gliricidia it is economical to select 15kg as a suitable rate to maintain the nutrient requirement of Arabica Coffee.

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124/B

### Evaluation and characterization of coffee varieties in mid country of Sri Lanka

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Arabica coffee (*Coffea arabica* L.), which gives premium price due to superior flavour and aroma, is more suited to cooler high elevation regions whereas robusta coffee (*Coffea canephora* Pierre) which is using for making instant coffee, is more suited for warm humid conditions though it has wider adaptability. In Sri Lanka, about 15800 ha are under coffee and out of that more than 60 % is in mid country. Average national productivity of coffee plantation is around 332 kg ha<sup>-1</sup> instead of potential yield over 1500 kg ha<sup>-1</sup>. This is far below value when compared to the production of newly developed varieties of coffee and it suggests that to use the developed varieties in future cultivations. The objectives of this study are to evaluate introduced varieties for the yield and adaptability to mid country of Sri Lanka and characterize those using leaves and berries.

Hence, seven robusta (S274, Q105, GCR, Q36, Q111, IMR, and Q96) and nine arabica (5A, S9, HDT, 6A, C2, S7d, S7t, S6d, S6t) introductions were evaluated at Matale in randomized complete block design with three replicates and 21 plants per plot. Though the experiment was established in 1975, the plants were collar pruned in 1999 and maintained as single stem one tire system with 1.5 m height. Standard agronomical practices were carried out and the yield data were recorded during four years. Leaves and ripened live berry samples were evaluated to determine their characteristics.

Results revealed that the varieties C2, GCR, S274 are the best varieties giving more than 2000 kg ha<sup>-1</sup> yr<sup>-1</sup> of mean processed bean yield for mid country agro-ecological conditions. Variety Q36 shows the biggest leaves (21.4 cm length and 10.25 cm width) among the robustas while S7d shows the smallest (11.85 cm length and 6.05 cm width) among the arabicas. Normally, arabica varieties are having dark green colour leaves specially, in variety HDT. Varieties C2, HDT, S9 and Q 105 show more than 1 g berry<sup>-1</sup> whereas varieties Q111, Q 96 and Q 36 show less than 0.5 g berry<sup>-1</sup>. Varieties IMR and Q111 show the lowest conversion rate of fresh yield into dry parchment yield (less than 3.5 :1) whereas varieties S6d, S6t and S7d gave the highest conversion rate of more than 4.5:1. Large berries are shown in Q111 (17.7 mm length, 17.1 mm width) and HDT (16.4 mm length, 13.7 mm width) whereas smallest berries are shown in S6t (11.6 mm length, 11.3 mm width). Plagiotropic branches are high in Q105 (23 plant<sup>-1</sup>) whereas number of berries per cushion is high in Q 96 (23 berries cushion<sup>-1</sup>). Therefore, varieties C2, GCR, S274 can be recommended for the mid country of Sri Lanka and other special characteristics of the different varieties can be used for the breeding activities.

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125/B

### Variability and correlation of leaf dry weight and related leaf characters of ten cultivars of true cinnamon (*Cinnamomum verum* Presl.)

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Key words: *Cinnamomum verum*, correlation, cultivar, Leaf oil, morphology, variability.

Cinnamon, (*Cinnamomum verum* Presl 2n=24) which is popularly termed as Ceylon cinnamon, indigenous as most say to Sri Lanka. Although the most significant perennial spice to Sri Lankan export economy in terms of both volume and value, it has been done little work regarding leaf morphology of cinnamon. Therefore, this study was undertaken to describe morphological variations of leaf length (cm), leaf width (cm), Leaf length / width ratio, leaf area (cm<sup>2</sup>), average leaf dry weight (g), leaf oil % and correlation among the characters of selected ten vegetatively propagated cultivars. Experiment was conducted at the Cinnamon Research Station, at Thihagoda, during 2006 to 2007. Vegetatively propagated selected ten cinnamon cultivars (CRS 351, CRS 166, CRS 156, CRS 23, CRS 201, CRS 83, CRS 317, CRS 184, CRS 318 and CRS 40) were used as treatments. Observations were recorded from five trees per cultivar and three replicates per each. Data were collected from randomly selected equally matured pests and diseases free 150 leaves of ten cultivars on above characters and leaf area was calculated by graphical method. Leaf dry weight was taken from same sample after five days oven dried at 70 °C and leaf oil % was determined by oil distillation method on dry basis. Experiment was repeated twice. According to the collected data regarding six leaf morphological characters showed significant difference among the selected cultivar (P < 0.001). Therefore the variation of leaf morphological characters could be used in characterization of true cinnamon cultivars. Among the various leaf characters, maximum variation was observed for dry weight of leaf (C.V. = 24.23) followed by leaf area (C.V.=17.63) . Inter character association of the six characters studied revealed highly significant positive association of leaf width with leaf area (r=0.94), leaf width with average leaf dry weight (r=0.83) and leaf area with leaf dry weight (r=0.81) and leaf length with leaf area (r=0.73). The highest negative association was observed between leaf width with length / width ratio (r= - 0.60). Out of five associations with leaf oil, only three were given significant difference, but all of them were negative (oil % with dry weight of r = - 0.52, leaf width r = - 0.46, leaf area r = - 0.44). Therefore, long and big leaf area types gave low leaf oil percentage and also due to evaporation of some volatile oils during the drying, total oil percentage could be reduced in dried leaves.

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126/B

### **Effect of fertilizer application on growth performance of Cinnamon (*Cinnamomum verum* Presl.) seedlings in nursery**

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**Key words:** *Cinnamomum verum*, fertilizer, growth performance, seedlings potting mixture

In order to maintain good cultivation of cinnamon (*Cinnamomum verum* Presl) in the field for a long period it is necessary to establish a good planting stock in the field. The establishment and survival of the planting stock in the field are mainly depend on the production of good quality planting stock which is mainly influenced by the size and vigor of the seedlings produced in the nursery. Therefore, the objective of this study was to investigate the effect of chemical fertilizers on growth performance of seedlings in the nursery. A net house experiment was carried out at Cinnamon Research Station to determine the effect chemical fertilizer on growth performance of cinnamon seedlings. The experiment was laid out in a Randomized Complete block Design with three replications of each treatment having four pots. Seven fertilizer treatments were allocated to asses the growth performance of seedlings planted in poly pots with soil mixture @ soil: sand in 3:1 ratio and nursery mixture @ Top soil: sand:

cow dung: coir dust in 1:1:1:1 ratio. Treatments consisted of levels of nutrients (N,P,K) of different fertilizer sources i.e., without fertilizer (control), 250 mg N (Urea), 250 mg N (Ammonium Sulphate), 250 mg N (Urea)+ 70 mg P(TSP)+160 mg K(MOP), 250 N mg (Ammonium Sulphate)+ 70 mg P(TSP)+160 mg K(MOP) and two foliar sprays (Crop master and T 65 tea mixture). At the end of the nursery periods, plant height, number of leaves per plant, shoot dry weight, root dry weights were measured. Results indicated that application of chemical fertilizer did not significantly increase plant height number of leaves per plant and root dry weight of seedlings. However, shoot dry weight was significantly ( $p < 0.05$ ) affected by fertilizer treatments. All the fertilizer treatments enhanced shoot dry weight and root dry weight of seedlings in nursery mixture. The maximum shoot and root dry weight of 1.33 g/plant and 0.41 g/plant were recorded for fertilizer treatment of 250 N mg (Ammonium Sulphate) + 70 mg P (TSP)+160 mg K(MOP) and T65 tea mixture which were increased by 27 % and 24% respectively compared to no fertilized treatment. Results also revealed that nursery mixture highly significantly ( $p < 0.001$ ) increased all the growth parameters of seedlings than soil mixture. In comparison with nursery mixture, the soil mixture significantly reduced plant height, number of leaves, shoot dry weight, root dry weight by 26%, 30%, 41% and 17% respectively.

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**127/B**

**The effects of soil moisture stress on the leaf water potential and yield of mungbean var. MI-6 at different growth stages**

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A study was conducted in the greenhouse of the Department of Botany, Eastern University, Sri Lanka to determine the effects of moisture stress on leaf water potential (LWP) and yield of mungbean variety MI-6 during the vegetative, flowering and pod-filling stages. The experiment was laid out in a Completely Randomized Design (CRD) with four treatments and thirty replications. Moisture stress was imposed at the above growth stages for a period of 12 days by withholding water completely at once. The control plants were watered to field capacity at four days interval.

Moisture stress significantly ( $P < 0.05$ ) reduced the LWP of mungbean and the reduction was highest when the stress was imposed at the pod-filling stage of the crop. Mature plants when subjected to moisture stress would have produced high amounts of secondary metabolites, which would have decreased the LWP to the highest extent. There was a partial recovery in the LWP of plants after re-watering during the vegetative and pod-filling stages.

Moisture stress significantly ( $P < 0.05$ ) reduced the yield of mungbean and the reduction was highest when the stress was imposed during the flowering stage. When the plants were exposed to moisture stress during the flowering stage, a severe flower drop was noticed. Abscission of flowers and reduced size of the newly produced flowers would have lead to the highest yield reduction during the flowering stage. Moisture stress at the vegetative stage also showed significantly ( $P < 0.05$ ) lower yield than the control treatment.

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128/B

### Some studies on liver and rumen flukes of cattle and buffaloes in Ja-Ela area of Gampaha district in Sri Lanka

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Fecal fluke egg output of cattle and buffaloes from three selected farms (A and B at Maeliya and C at Delathure) in Ja-Ela area of Gampaha district in Sri Lanka were examined for six months period from July 2006 to December 2006.

Regression analysis revealed that there was no correlation between mean monthly faecal egg output/g and monthly mean rainfall. However, there was an increasing trend of egg output with increasing rainfall. Same test revealed that there was no correlation between mean egg count/g and monthly mean temperature. In contrast, there was a decreasing trend of egg output with increasing temperature.

Usually female cattle had a higher fecal fluke egg output ( $\bar{x}=202.76$ ;  $n=18$ ) than the male cattle ( $\bar{x}=116.97$ ;  $n=18$ ) but egg output did not significantly differ. Also there was an increasing trend of mean fecal fluke egg count with the increment of age in cattle ( $R^2=0.6057$ ).

Infected liver and rumen portions from seven slaughtered cattle and buffaloes lived in the study area were obtained and they were examined for the presence of flukes. Flukes found during the observation were identified by making histological sections and preparing whole mounts. During this study one species of liver flukes namely *Explanatum explanatum* and four species of rumen flukes namely *Paramphistomum* spp, *Gastrothylax crumenifer*, *Carmyerius* spp and *Fischoederius elongates* were identified. In addition, two other rumen flukes belonging to family Gastrothylacidae were also recorded. *Explanatum explanatum* was known to be a great cause in condemnation of liver at slaughterhouses in Sri Lanka.

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129/B

### Iron content and *in vitro* availability of iron in cooked *Sardinella albella* and *Exocoetus volitans*

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Iron deficiency is one of the most common nutritional disorders prevailing in developing countries in particular. One of the major causes of the high prevalence of iron deficiency in low income countries is an insufficient iron intake as well as low bioavailability of iron in the diets. As Sri Lankans are more accessible to diets with a wide range of fish species, the objective of the present study was to investigate iron content and its *in vitro* availability in two small fish species *Sardinella albella* (Sudaya in Sinhala / Sudai in Tamil) and *Exocoetus volitans* (Piyamassa in Sinhala / Kolameen in Tamil). *In vitro* iron availability of cooked fish flesh was measured as iron solubility at physiological conditions according to the method of Svanberg *et al.*, (1993) with certain minor modifications. The total amount

of iron in the cooked fish flesh, cooked fish bones, cooking water was determined by using Atomic Absorption Spectroscopy. The data analysed statistically using MINITAB are given in the Table 1.

Table 1: Iron content and *in vitro* iron availability of cooked fish of *S. albella* and *E. volitans*.

Fish species	Cooked fish flesh $\mu\text{g/g}$ , (DW)	Cooked fish bones $\mu\text{g/g}$ , (DW)	Cooking water medium $\mu\text{g/ml}$	<i>In vitro</i> iron content $\mu\text{g/g}$ , DW (cooked fish flesh)
<i>E. volitans</i>	199.1 $\pm$ 7.8 <sup>a</sup>	191.9 $\pm$ 6.1 <sup>a</sup>	21.0 $\pm$ 2.4 <sup>a</sup>	56.1 $\pm$ 5.1 <sup>a</sup>
<i>S. albella</i>	322.0 $\pm$ 6.0 <sup>b</sup>	155.7 $\pm$ 10.3 <sup>b</sup>	41.6 $\pm$ 4.0 <sup>b</sup>	72.6 $\pm$ 4.5 <sup>a</sup>

Mean values  $\pm$  Standard error of Mean n = 3; a, b; Significance difference are denoted by different superscripts ( $p < 0.05$ ). DW- on dry weight basis

The results show that the iron contents in the fish flesh ( $p < 0.05$ ) and cooking water medium ( $p < 0.05$ ) of *S. albella* formed after *in vitro* digestion were significantly higher than those of *E. volitans*. The iron content in bones of *E. volitans* ( $p < 0.05$ ) was significantly higher than that of *S. albella*. There was no significant difference ( $p > 0.05$ ) between the *in vitro* available iron content in these fish species. Although there was a considerable amount of iron in these fish species, the iron availability is lower. In fish bones of *E. volitans*, the iron content was found to be higher compared with other species studied. As it was difficult to remove the smaller bones in the flesh, the iron content in cooked fish flesh of *S. albella* gives a higher figure. As the cooking water medium contains a substantial amount of iron, the consumption of gravy in a fish curry along with the fish flesh may increase the amount of iron available to the consumer.

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## 130/B

### Coconut galactomannans stimulate favorable gut microbes and lowers serum total and LDL cholesterol in broiler chickens

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A feeding trial of 5 weeks duration was conducted to investigate the prebiotic effect of a galactomannan (galactose : mannose ratio: 1:5) isolated from coconut meal polysaccharides on gut microbes and serum lipid profile of broiler chickens.

One hundred and twenty chicks (Hubard, 15 days old) were housed in 12 cages (10 per cage). An on-farm prepared control diet and two test diets containing galactomannans added at 750 and 1500 ppm were randomly assigned to the 12 groups of chicks with 4 replicates. Feeds and water were offered *ad libitum* for five weeks. Group feed intake and body weights were recorded weekly. At the termination, birds were slaughtered and ileal and caecal contents were aseptically transferred to pre-prepared McCartney bottles. Lactic acid bacteria were enumerated on de Man, Rogosa, and Sharp agar-MRS, after anaerobic incubation at 37°C, 48 h. Coliform bacteria were counted on MacConkey

agar after aerobic incubation at 35°C for 24 h. The weights of liver and the skinned carcass were recorded for each bird. Blood samples collected at slaughter were subjected to lipid profile analysis. Colony Forming Units (log CFU/ g content) of lactic acid bacteria in ileal (9.73) and caecal (10.41) contents were significantly increased ( $P > 0.05$ ) to 10.65 and 10.69, respectively, when the diet was supplemented with 1500 ppm galactomannan. A general reduction in coliform bacteria was also observed. Feed intake and weight gain were not affected by treatments. A significant decrease ( $P < 0.05$ ) in the total cholesterol (from 190.25 mg/dl to 120.3 mg/dl) and LDL -cholesterol (from 126.1g/dl to 63.6 g/dl) were demonstrated with 1500 ppm galactomannan supplemented diet while the changes in the HDL cholesterol were not significant. Galactomannan from coconut meal polysaccharides has prebiotic effect on the growth of lactic acid bacteria in chicken intestine and reduces the total serum cholesterol and LDL cholesterol levels in broiler chickens.

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### 131/B

#### **Effects of dietary phytase supplementation on water intake and digesta moisture contents of broiler chicken**

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Beneficial effects of exogenous microbial phytase on the utilization efficiency of dietary phytate phosphorus, other minerals, protein and energy, and mineral excretion are well known. Objective of the present study was to determine the effects of dietary phytase supplementation on water intake and ileal digesta moisture contents of broiler chicks. Twenty one day old broiler chicks ( $n=50$ ) were randomly allocated into 10 cages. Cages were assigned into two experimental diets. From day 21-40 birds were fed one of two diets; 1) diet with 0 FTU of microbial phytase or 2) a diet with 1000 FTU of microbial phytase/kg. Both diets met the recommended nutrient levels and were in mash form. Each cage had a drinker and a feeder. Daily water and feed intakes were measured from day 34-40. Moisture contents of the ileal digesta samples collected from five randomly selected birds from each treatment were determined. The daily feed intake of the broilers given no dietary phytase ( $146 \pm 2.6$ ) was significantly ( $p < 0.001$ ) increased to  $155 \pm 1.8$  when diet was supplemented with microbial phytase. Daily water intake of the birds given diets with phytase was also significantly higher ( $p < 0.001$ ) than those birds given no dietary phytase ( $294 \pm 4$  vs.  $330 \pm 10$  ml/day). Daily water: feed ratio of the birds given diets with phytase was also significantly higher ( $p < 0.05$ ) than that of birds given no dietary phytase ( $2.0 \pm 0.04$  vs.  $2.22 \pm 0.04 \pm$ ). Moisture content of the ileal digesta of the birds given phytase supplemented diet ( $42.7 \pm 6.6$ ) was significantly ( $p < 0.001$ ) higher than that of broilers given no dietary phytase ( $26.7 \pm 5.7$ ) It was concluded that supplementation of broiler diets with microbial phytase increased the water intake and moisture content of the ileal digesta.

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132/B

### Hygienic quality assessment of raw cows milk in MILCO farmers (A case study in Akurugoda area)

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The demand for fresh milk in the country is increasing and the consumers are more concern about the quality of milk. The cattle farmers in Akurugoda area are small holders and milk production is prevailing in small scale. Therefore, it is necessary to improve milk quality by reducing the contamination at farm level, to provide the increasing demand for quality milk in the local market.

The objectives of the study were to identify the existing management practices and to assess the hygienic quality of raw milk in selected neat cattle farms belongs to the collection network of MILCO (Pvt) Ltd. The study was carried out in Akurugoda GN division. Randomly selected 30 farms were investigated using a pre-tested questionnaire. The hygienic quality of raw cow milk was ascertained by investigating the following parameters using standard methods; Total Plate Count (TPC), Somatic Cell Count (SCC), Methylene Blue Dye Reduction Time (MBDRT), pH and titratable acidity. These quality parameters were investigated on both beginning and bulk milk samples of each animal. Resulted quality values were compared with standard raw milk quality values. Lactometer reading and CMT were done as on-farm tests for all thirty samples. Repeated sampling was also taken. Data were analyzed using both qualitative and quantitative statistical methods. All the animals were cross-bred animals with various degree of European blood to a lesser extent with Sahiwal blood. TPC, pH and acidity values of beginning milk samples were similar to the values given for standard raw milk. Significant differences ( $P < 0.05$ ) were observed in acidity and pH of bulk milk samples and milk samples drawn at the very beginning of milking. Significantly higher acidity and lower pH values were observed in bulk milk samples. In the selected sample 40% of the animals were detected for sub clinical mastitis. It can be concluded from the above study that the quality of the raw milk in terms of TPC, pH, and acidity is comply with the standard quality parameters stipulated for raw milk. Significantly higher acidity and lower pH values were reported in bulk milk samples, than the milk samples taken at the very beginning. It can be due to the milk handling and storage problems. This can be minimized by proper hygienic milking and handling and this is essential since the bulk milk directly influence the quality of the final milk consumed.

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133/B

### Early seedling growth of tomato (*Lycopersicon esculentum* L.) as affected by different types of compost tea

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The research was conducted at the Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, to study the effect of compost tea on early seedling growth of tomato.

Topsoil, sand and compost were mixed at 1:1:1 ratio to prepare the nursery mixture and black polythene bags (8×12 cm) were filled. Pre germinated three tomato seeds of Variety T 245 were planted in a polythene bag. Nine different types of compost were taken, which has nine different compositions for the preparation of compost. Banana stem (BS) 10, 20, 30, 40, 50, 60, 70, 80 and 90 Kg were mixed with Fruit Processing Factory Waste (FPFW) 90, 80, 70, 60, 50, 40, 30, 20 and 10 respectively to make 100 Kg of total bulk. *Gliricidia* and cow dung were added to every type of BS and FPFW mixture at constant rate of 2 kg each. Compost tea was prepared by soaking 100 g of compost for 24 hours in 1 liter of water. 50 ml of each type of compost tea was applied to the poly bag in every other day. Experiment was set up according to the Completely Randomized Design with three replicates. Number of leaves per plant and plant height were recorded as growth parameter in weekly interval.

The highest number of leaves per plant was observed in the treatment of compost tea out of BS: FPFW in 1:1 ratio. In the treatment of compost tea made out from compost with BS: FPFW in 3:7 ratio gave the lowest number of leaves per week during the entire growing period. Results also revealed that, treatment of tea made out from compost consist of BS: FPFW (1:1) ratio recorded the highest plant height (14.15 cm) during three weeks of nursery period. It can be concluded that, tea made out from the compost which has 1:1 ratio of Banana Stem (BS) and Fruit Processing Factory Waste (FPFW) could be used as a liquid fertilizer for tomato nursery to obtain vigorous plants for field planting.

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**134/B**

### **Bathiya (HF 02)-An Indeterminate type F1 hybrid tomato with bacterial wilt resistance and high yield potential**

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Bacterial wilt of tomato incited by *Ralstonia solanacearum* is one of the most important and ubiquitous vascular diseases in tomato causing 10.8 to 90.6 percent yield loss. The effective method to manage this soil borne disease is growing resistant hybrid/open pollinated variety. At present consumers are much concerned about the yield and quality of fruits. Therefore, keeping this in view, the hybrid varietal development programme was initiated at Horticultural Crops Research and Development Institute, Gannoruwa during 1999-2006.

Several crosses using 10 promising donor parents were performed and one hybrid originating from a single cross combination was found to be promising. The yield evaluation studies in Randomized Complete Block Design with 7 exotic hybrids and two check varieties namely Maheshi (hybrid variety) and Rajitha (open pollinated variety) were carried out for 2 seasons. The hybrid Bathiya consistently gave significantly higher yields than all the tested varieties. The laboratory and field screening tests revealed that it is resistant to bacterial wilt disease. The consumer preference of this hybrid variety is very high due to the dark red fruit colour, shiny appearance, thick pericarp, long shelf life period and non cracking nature of fruits.

The weight of the fruit is about 75 g and yield potential is 67.2 t/ha and it is about 35 % higher than the recommended variety, Rajitha. The new hybrid variety Bathiya is a potential nominee for the varietal release in near future.

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### 135/B

#### **Growth performances of knolkhol (*Brassica oleracea* Var. *gongyloides*) as affected by different potting media and organic liquid fertilizers**

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The study was conducted at the Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya to study the growth performances of knolkhol with different potting media and liquid organic fertilizer. Three different potting media [coir dust, sand: coir dust (1:1) and topsoil: coir dust (1:1)] and three types of liquid organic fertilizer [Municipal Compost Tea (MCT), Farm Compost Tea (FCT) and Cow dung Tea (CT)] were taken to test the growth performances of knolkhol.

Growth media were mixed into the correct ratios and black horizontal polythene bags (0.75×0.25×0.10 m) were filled. In each horizontal bag six planting holes were prepared in 12.5 cm spacing. Three replicates from each treatment were taken for the experiment accordingly with Completely Randomized Design (2<sup>n</sup>). Variety Early White Viena was taken and direct seeded. Excess seedlings were thin out by leaving one seedling per planting hole after one week of planting. The tea of each organic fertilizer was prepared by soaking 100 g of each one for 24 hours in 1 liter of water and filtrate was taken as the liquid organic fertilizer. The 50 ml of organic fertilizer was applied per plant once in two day intervals. Number of leaves per week was recorded as growth parameter in weekly interval. Eight weeks old plants were harvested to record the fresh weight of the knolkhol. ANOVA was used to analyze data using MINITAB.

The highest fresh weight (431.6 g) was recorded in the treatment comprising topsoil: coir dust (1:1) growth media with Farm Compost Tea (FCT) followed by topsoil: coir dust (1:1) with Cow dung Tea (CT) (237.8 g) (significant at p<0.05). The lowest fresh weight (16.2 g) was observed in the treatment of coir dust with Municipal Compost Tea (MCT) at 5% probability level. Poor and late plant growth of knolkhol was observed during the entire growth period in most of the treatments. According to the observed results, in organic vegetable cultivation topsoil: coir dust (1:1) growth media with farm compost tea can be used to obtain the highest yield of knolkhol.

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### 136/B

#### **Drought-induced guard cell signal transduction involves calcium dependant protein kinase 8; (CDPK8)**

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Drought is a major constrain for plant growth and crop productivity. Plants loss over 90 % of water by transpiration through stomatal pores formed by pairs of guard cells on the leaf surface. The cytosolic free  $Ca^{2+}$  shown to be elevated in guard cells in response to stress stimuli which triggers stomatal closure. The plant-specific calcium-dependent protein kinases (CDPKs) play important roles in regulating downstream components of calcium signaling. The objective of this study was to elucidate the function of CDPK8 gene in response to drought stress. CDPK8 knockout mutant plants were compared with the wild type *Arabidopsis thaliana* ecotype Colombia in response to drought. Water loss by leaves was observed to compare their transpiration rates. Stomatal apertures were measured with  $H_2O_2$  and  $Ca^{2+}$  treatments. CDPK8 gene expression was compared by RT-PCR in wild type and mutant plants.

Our data indicated that *Arabidopsis* CDPK8 gene (encoded by *WDSS1*) is involved in plant responses to water stress. *WDSS1* knockout mutants (*wdss1*) showed more sensitive phenotype and higher transpiration rate under water deficit condition compared to wild type plants. The GUS staining studies confirmed that *WDSS1* was expressed in guard cells. The finding of strong expression of *WDSS1* in guard cells suggests that *WDSS1* may play a role in stomatal function. Stomatal experiments showed that pre-opened *wdss1* stomata failed to close in response to  $H_2O_2$  and  $Ca^{2+}$ , which is consistent with the inability of *wdss1* plants to reduce water loss upon drought. Our data indicated that the *wdss1* mutations do not cause a general defect in stomatal functioning but specifically disrupt  $H_2O_2$  signaling in guard cells. The drought susceptibility and stomatal impairment in response to  $H_2O_2$  and  $Ca^{2+}$  of the *wdss1* mutant plants implicated that *WDSS1* gene is a compulsory molecule in the transduction of  $H_2O_2$  signal in guard cells in response to drought stress.

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137/B

### Callus formation and plant regeneration in *Lilium* asiatic and oriental hybrids

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Callus induction and subsequent plant regeneration was studies in four *Lilium* cultivars; viz. *Lilium* Asiatic hybrids cv. Golden Melody and cv. Orange Pixie, *Lilium* Oriental hybrids cv. Yelloween and cv. Crystal Light to standardize the type of explant and level of growth regulators. Different explants such as transverse thin cell layers of young stems (stem tTCLs) and bulb tissue (bulb tTCLs), Leaf pieces, shoot buds, / axillary buds and bulb scale basal segments were used to induce callus on MS media supplemented with BA and NAA at different concentrations and combinations. Cultures were established in Petri plates. Experiments were conducted according to a complete randomized design; each treatment had 10 samples and was replicated thrice. Data was analyzed using the computer soft ware; 'statistical package for agricultural workers'. Transverse thin cell layers of young stems recorded the highest callus initiation (85, 72, 82 & 81 % for cultivars Golden Melody, Orange Pixie, Yelloween and Crystal Light respectively) followed by bulb scale basal segments on MS basal medium supplemented with 0.5 mg/L BA and 1.75 mg/L NAA (83, 65, 81 & 81 % respectively for the same cultivars). Development of shoots was observed from callus cultured on MS medium supplemented with 0.5 mg/L BA. Percent callus formation varied for all explants among the different *Lilium* varieties used in the study. *Lilium* Asiatic hybrid cv. Golden Melody was most responsive (85 & 83 % callus formation for best explants; stem tTCL and bulb scale basal segments). Followed by, Oriental hybrids cvs. Yelloween and Crystal Light (82, 81 & 81 % each for best explants; stem tTCL

and bulb scale basal segments) Lowest percent callus formation was observed in the Asiatic hybrid Orange Pixie (72 & 65% for stem tTCLs and bulb scale basal segments). Among the auxins tried NAA at 1.0 mg/L was the best for rhizogenesis. Bulb formation and enlargement was enhanced with an increased sucrose concentration of 45 g/L supplemented to a plain MS medium. Rooted bulblets were successfully transplanted and grown in a potting mixture of FYM and soil at a ratio of 3:1 under green house conditions with 75% survival of bulblets.

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## **SECTION C**

### **301/C**

#### **Sustainable management of lagoon resources – A study of Puttalam lagoon and associated coastal resources**

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Puttalam lagoon is one of the productive estuaries in the Northwest coast of Sri Lanka and is very rich in natural resources such as fish, shellfish, coral reefs, sand dunes, mangroves, sea grass beds, salt marshes and beaches. Human activities within and outside the system have resulted in the degradation of these valuable resources.

A study was carried out to investigate the issues related to the degradation of coastal resources in Puttalam lagoon and to propose management options that can be implemented for managing the coastal resources in the lagoon in a sustainable manner.

A literature survey on coastal resources and the present management plans of Puttalam lagoon was carried out. Various organizations were contacted for collecting necessary data. In addition, socio-economic surveys and focus group discussions were conducted at four different places around Puttalam lagoon, meeting various categories of people.

Major issues contributing to the degradation of coastal resources in Puttalam estuarine system can be classified into four categories as aquaculture, fishing and lagoon resources, ecological habitats and lagoon water quality. Some of the important issues are, unauthorized shrimp farm development, water source pollution & sedimentation due to untreated farm effluent, use of harmful fishing methods & gears, over fishing, catching & discarding trash fish, difficulties in entering into sea fishing, increase in number of fishermen, destruction of ecological habitats for livelihood & commercial activities such as shrimp farm development, increased threat to lagoon resources due to influx of refugees, destruction of habitats lead to reduction of fish varieties & affect wild life, dumping of garbage into the lagoon & pollution caused by chemical usage in the agricultural sector.

In addition, poverty and increase in population, lack of alternatives, lack of awareness, paucity of funds, non-compliance with the laws, political interferences, legal/institutional constraints and poor coordination among different institutions and agencies are some of the general issues that directly influence the sustainable use of lagoon resources.

Some of the proposed management options are, mandatory EIA for shrimp farm development, regular water-quality monitoring program, new methods for shrimp farm effluent treatment, desiltation of the most crucially silted areas, a land-use master plan for aquaculture, immediate licensing of all fishing crafts/gears, limiting fiber reinforced plastic boats, control of harmful fishing practices, restriction of the minimum mesh size to 20mm, support from government to setup fisheries committees, zoning mangrove patches, restriction of utilization of ecological habitats, resettlement of refugees from echo-resources rich areas, Introducing environmental friendly alternatives for livelihood and proper treatment of shrimp farm effluent before discharging into the lagoon.

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**302/C**

### **Experimental investigation of jatropha oil based bio-diesel in compression ignition engines**

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The rapid depletion of crude oil and ever increasing price of fossil fuel has led to search for alternative fuels. With consideration of above project on "Experimental Investigation of Jatropha oil Based Bio-Diesel for Compression Ignition Engines" was conducted at the Department of Mechanical and Manufacturing, Faculty of Engineering, University of Ruhuna. Jatropha oil was taken as the base fuel for bio diesel. Jatropha oil was extracted from the seeds collected from Moneragala district. The extracted oil then cleaned from solid impurities and transesterification was done. Both the raw oil and transesterified bio-diesel were tested for main important properties such as density, viscosity, saponification value, acid value, flash point, calorific value etc.

A single cylinder direct ignition four stroke diesel engine was used to test the different configurations of fuels. Fuel configurations were 95% diesel with 5% raw Jatropha oil (B5), 90% diesel with 10% biodiesel (B10), and 95% diesel with 5% raw Jatropha oil. Diesel oil 100% by volume was used for bench mark for the comparison. It was found that Jatropha oil based bio diesel has similar properties, as diesel oil the performance of the engine seems to be comparable. The fuel consumption with bio diesel has improved and this could be attributed due to the presence of oxygen in Jatropha oil.

Jatropha oil has substantial prospects as a long-term substitute for diesel fuels. The B5, B10 fuel blends competed favourably with diesel fuel and offers a reasonable, if not even a better, substitute for pure diesel oil. It has been established that Jatropha oil can be used as a substitute for diesel oil for use in compression ignition engines without major operational difficulties. However, the proportion of the blends may be further improved to make use of higher percentage of Jatropha oil in the blend using Jatropha oil purer grade which may be obtained by pretreatment of the oil. Moreover, the long term durability of the engine while using bio-diesel as fuel requires further study.

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**303/C**

### **Factors affecting the adsorption of Pb and Cu ions on to granular activated carbon**

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Adsorption of Pb and Cu ions from aqueous solutions onto granular activated carbon was studied. Batch experiments showed that the sorption process was rapid and pH dependent. Highest metal uptake was recorded above solution pH 5. Initial rapid adsorption followed by a slow adsorption was observed for both Pb and Cu. Pb showed higher adsorption rate compared to Cu. The adsorption process conformed to the Freundlich and Langmuir isotherms. Langmuir monolayer adsorption capacities of 28 and 19 mg/g were observed at 22 °C for Pb and Cu respectively. The adsorbent to solution ratio and the metal ion concentration in the solution affects the degree of adsorption. Higher percent of metal removal were observed at high adsorbent doses due to the increase in number of adsorption sites or surface area with the weight of adsorbent. Minimum amount of adsorbent required for 99% removal of Pb and Cu from a 200 ppm solution were 8 and 15 g/L respectively. Decrease in

activated carbon particle size led to an increase in the sorption of metal ions and this could be explained by an increase in surface area and hence binding sites. Increase in the total metal uptake was observed when both Cu and Pb ions are present in the solution. The affinity of activated carbon for Pb was greater than Cu under all the experimental conditions tested. Breakthrough curves were obtained from fixed bed column studies and adsorption capacities were lower compared to batch adsorption. For 100 ppm metal concentrations, fixed bed column adsorption capacities for Pb and Cu were 19 and 8 mg/g respectively.

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### **304/C**

#### **Design and development of a domestic lamp for lighting using jatropha/castor oils**

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Not the entire population in Sri Lanka has the access to grid electricity and about 35-40% will not have grid power within next 10-20 years to come. There is a large portion of population who use kerosene oil for lighting purpose and an ever-increasing fossil fuel prices make it difficult to afford purchasing kerosene at high prices. With that information in mind we have embarked on a project to design a lamp for illumination, which can use Jatropha or Castor oil, which are already available in the remote areas where the grid has not arrived. The main feature of designed lamp is that it can use high viscous oils such as Jatropha or Castor, which is not appropriate for existing kerosene lamp.

Properties of castor oil such as Viscosity, Density, Flash Point, Calorific Value Saponification Value, and Acid Value were found at the laboratory. By considering the properties and the availability of the oils, Castor oil is considered for further investigation as a fuel for the lamp to be designed. Two main designs namely, Slim Lamp, which based on the maximum absorbing height of the castor oil for the selected wick material and the Floater Lamp which based on the floatability on the oil with the help of the floater were designed. With the comparison of fabrication capability at domestic level, safety in the domestic environment, portability, maximum oil capacity, fabrication cost and maintenance the Floater Lamp is selected as the optimum design. Design calculations and experiments were done for the floater lamp to select a suitable wick from the available wicks, floater calculations to certify the floatability, chimney calculations to keep a better inlet and exhaust air flow.

The designed lamp was tested for its consumption of castor oil versus time which showed increased burning / illumination duration compared to the same quantity of kerosene oil. The designed lamp could be used to ignite highly viscous fuel oils where the specific gravity remains above 0.9 and with a flash point above 100°C, which in terms prevents fire hazard ness in accidents.

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**305/C**

**Grass-root stakeholder involvement for identifying causes for natural disasters in riverine environments: Ma Oya case study**

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Natural disasters are often linked with the excessive use of natural resources. Floods, land erosions and droughts are three major natural disasters that can be linked to river basins. The objective of this study is to identify the possible reasons for natural disasters in a river and its valley through a process developed for eliciting grass-root level stakeholder knowledge. Grass-root stakeholder involvement could result in unfolding the real life socio/political situations, which could otherwise lie beneath the rationale, put forward at professional levels. The study was carried out in the middle reaches of Ma Oya river basin situated in North Western Sri Lanka.

The two major natural disasters identified by the stakeholders are the damages to the river embankments and property during floods and the prolonged dry seasons with water scarcity nearing drought situation. The major cause for both the above disastrous situations identified is the excessive levels of sand mining in the riverbed. Interestingly, the stakeholders voiced their opinions on a number of possible remedial actions that could be taken to improve the situation such as building short dams across the river at selected locations to raise the water level and demarcation of river reservations. Indiscriminate and illicit felling of trees along both banks and in the upper catchment and mechanized clay mining on the banks of the river and its tributaries are identified as the other contributory factors. The study showed that involvement of grass-root stakeholders could elicit actual situation and also that they could provide with real life solutions to improve the situations.

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**306/C**

**Use of a hydrodynamic model to predict Kalu Ganga floods**

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Flooding is one of the most frequent and devastating natural hazards in the Kalutara and Ratnapura districts of Sri Lanka. These floods are due to Kalu Ganga, which flows through these two districts. Floods in these areas have caused impacts on society that go beyond economical cost and facilities, including impacts such as family and community disruptions, dislocation, injuries and unemployment. For example, during the recent major flood in the year 2003, about 52,000 families were evacuated. It is therefore, very vital in these areas to control or make the public aware in advance of such floods to minimize negative impacts due to floods.

Controlling floods using structures, such as flood control reservoirs, could be very expensive. Besides they can create many negative environmental impacts. By warning people at risk in advance of

possible floods based on a flood forecasting mechanism the damage due to floods could be minimized.

Floods along a river could be simulated based on a hydrodynamic model, which enables forecasting of floods at downstream locations. This paper presents the use of the hydrodynamic model HEC-RAS in the prediction of floods along the Kalu Ganga from Ratnapura to Kalutara. The model requires river geometry and friction as the basic data in addition to hydrological data. The model was calibrated for the Kalu Ganga based on rating curves at several sections along the river and verified based on a historical flood event.

The model predicts the time a flood would take to travel from Ratnapura to any location downstream up to Kalutara. Its prediction includes the magnitude of the flood at the location of interest. The model also provides the inundation area along the river.

Key words: Flood forecasting, hydrodynamic model

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**307/C**

### **Earthquake effect on a Weir**

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Key words: Plane strain, isoparametric, earthquake

The recent tsunami disaster has brought into focus the need for consideration of disasters caused by such infrequent events. Even though earthquakes have hit Sri Lanka more often than tsunami, fortunately the earthquakes struck during the recent past were not of intensities sufficient to cause destruction of significant scale. Nevertheless, earthquakes of greater intensity may strike the country, and in such an event the adverse effects may not be confined to the coastal regions but spread throughout in the country. It is recognized that damages caused by an earthquake on structures essential for public life particularly during the post-disaster period are of serious concern.

The aim of this study is to investigate the response of a weir to earthquake loading. A fictitious structure of typical configuration applied for diversion of streams for irrigation or hydropower generation purposes was used in this study.

A two dimensional (plane strain) stress analysis was carried out on the weir cross-section using SAP2000 finite element code. Four-node quadrilateral isoparametric elements were used for the analysis. The bottom boundary was considered as a rigid base and it was fixed against both vertical and horizontal displacements. This approximation was considered to be reasonable enough since the bedrock can be considered to be rigid compared to the weir. The weir is constructed using Grade 25 concrete.

Analyses were done for ultimate limit state condition and the results are compared and discussed in this study. The combination of loads on the weir due to hydrostatic pressure at the upstream and downstream, the self weight of the weir and the load due to water in the stilling basin, was mainly considered in the analysis. In addition to the above load cases, moderate earthquake effect was

considered ranging from 10 to 50 percent of ground acceleration along the flow direction and through the weir as well.

Based on the analysis results of ultimate limit state load case, it was observed that the highest tensile stresses are developed at the upstream toe whilst compressive stresses are found in other areas. With the earthquake load increased along the flow direction, it was observed that the tensile stresses in upstream toe further increased while the other areas were still under compression. Nevertheless, no considerable effect was seen for the earthquake load increased along the weir. The study portrays the extent of special treatment for moderate earthquake effects.

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### **308/C**

#### **Impacts of reduced diversions on the Upper Kotmale Project**

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Hydropower has always been the major source of energy for electricity generation in the absence of coal and fossil fuel deposits in Sri Lanka. Upper Kotmale Hydropower Project, which is under construction in the Mahaweli basin, has been planned to contribute to the power requirement in Sri Lanka. The project consists of a 34 m high concrete gravity dam across Kotmale Oya at Talawakele with a pond capacity of  $0.8 \times 10^6 \text{ m}^3$ . The original project, which consisted of diverting waters above seven scenic waterfalls namely, Ramboda upper and lower falls, Puna, Pundal, St.Clair's, St.Andrew's and Devon falls, was later reduced to obtaining water only from the Kotmale Oya to minimize impacts on the environment.

A simulation model for the Upper Kotmale Hydropower Project was developed based on System Dynamics approach to compare several different system configurations and system operation patterns. The model has been developed using the Vensim simulation environment, which facilitates use of the system dynamics modeling objects such as reservoirs, flows, feedback mechanisms and delays. The results indicate that the exclusion of diverting water of waterfalls Devon, Andrews, Puna Oya No1, Puna Oya No2, Pundal oya and Pundal falls results in the reduction of about 25% of total system hydro energy generation. Impact of water diversions from Andrews and Pundal Falls on energy output is observed to be very small. Out of the water diversions, contributions of Devon and Pundal Oya on system hydro energy production are observed to be relatively high. The model was used to study impact of several operational patterns on system output. These operation policies, which considered making different minimum releases to sustain St.Clair's water fall located downstream of Talawakele pond, has only little impact on the system out put.

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### **309/C**

#### **A device for climbing a vertical member such as a coconut tree or pole**

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Present method of climbing vertical member such as pole or coconut palm is to use a girdle or small loop made out of coconut fiber/leaflets round the climber's ankles to hold/tighten the feet together in order to firmly grip to the vertical tree or pole. Climber has to exhaustively use leg and hand muscles to go up the trunk like a "looper caterpillar" with strain to the spin. This method often results in undesirable skin marks on legs and hands disliked by many.

Hence considering the human fatigue and danger involved in this method of climbing vertical tree or pole, it is essential to introduce an appropriate and simple device to climb tree or vertical pole with adequate safety and less fatigue.

Considering above facts, a manually operated low cost tree climbing device was designed and constructed. It consists of an upper engagement rope ladder and a lower engagement foot supporting unit, which can be opened or closed to respectively engage an upper and lower portion of the vertical member. At least one extension/retraction member is connected to the upper and lower engagement members. The extension/retraction member extends or retracts to vary the distance between the upper and lower engagement members. Two experiments were conducted to evaluate the performance of the designed device. First experiment was conducted in the faculty farm and second was conducted in the coconut plantation after having few modifications to the first prototype. Climbing time per plant and harvesting cost were conceded as criteria for evaluation the device. Farmer opinions are also collected.

The designed coconut climber is a novel simple device that could be manufactured locally at a cost of Rs 800 to 1000. The leg movement is similar to climbing along a ladder with intermitted rest period and hence not strenuous or requires no special training. It is an appropriate and simple device to climb coconut palms or vertical pole with adequate safety and less fatigue. But its take more time than present method of climbing coconut palms using a small loop made out of coconut fiber.

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### **310/C**

#### **Accuracy of discharge measurements in open channels using double 'v' notch, compound sharp-crested weirs**

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Although the combination of a rectangular notch and a 'V' notch weir is commonly used, the continuity of flow and precision of this type of compound sharp-crested weirs are reported to be poor in the transition region between the two sections. As an improvement, a compound sharp-crested weir (Figure 1), composed of two triangular parts with different notch angles has been designed and experimentally validated which proved to be accurate in measuring a wide range of discharges without any discontinuity. The discharge over the designed Compound sharp-crested weir is

estimated by adding the

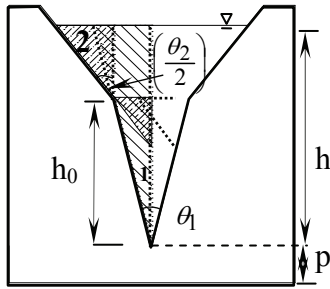


Figure 1- Typical cross section of the compound sharp-crested weir

flow through the triangular areas 1 & 2 and subtracting the flow through the relevant intersected triangular area as shown in Figure 1. Several methods are proposed to estimate the flow over the double 'V' notch, compound sharp-crested weir by changing the position of the intersection triangle (upper/lower) and the discharge coefficient of the intersection triangle. From a detailed analysis, one method is identified as most suitable to measure the discharge over the weir in partially contracted flow conditions

According to the method selected (figure 2), the discharge measurements are accurate when the intersection triangle is in the upper 'V' notch and the discharge coefficient of that part is taken as the discharge coefficient of the upper 'V' notch. It is observed that the accuracy of the measurements is nearly the same as single 'V' notches, which form the compound weir while the continuity of flow over the compound weir exists. Standard 'V' notch equation is used to estimate the flow over the weir when  $h < h_0$  and when  $h > h_0$ , the discharge is computed by using the proposed equation as follows;

$$Q = \frac{8}{15} C_{dc} \sqrt{2g} h^{2.5} \text{ Where,}$$

$$C_{dc} = C_{d1} \tan\left(\frac{\theta_1}{2}\right) + C_{d2} \left[ \tan\left(\frac{\theta_2}{2}\right) - \tan\left(\frac{\theta_1}{2}\right) \right] \left(1 - \frac{h_0}{h}\right)^{2.5}, \quad C_{d1} \& \quad C_{d2}$$

are the discharge coefficients of lower and upper 'V' notches, respectively.

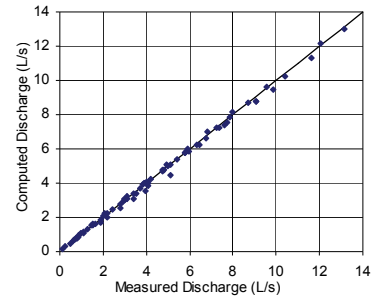


Figure 2- Measured Vs computed discharges using proposed method

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311/C

### Investigation of design parameters of traditional Sri Lankan mural paintings

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Design parameters of traditional Sri Lankan mural paintings were investigated to obtain a clear view and in-depth understanding about traditional technology and the production processes of mural paintings. Mural paintings in five traditional sites were selected for the study. Hourly variation of relative humidity and temperature of these image houses and surface moisture level, the rate of moisture evaporation and surface movement in paintings were measured and absorbed amount of water per day was estimated. Simulated samples of traditional mural paintings were produced, these samples were placed in constant environment and above parameters were measured. Surface conductance and mass difference were the actual parameters measured. Movement was observed

under the microscope. Surface movement observed in sites amounted to the order of  $10 \mu\text{m h}^{-1}$ . It was found that the surface movement was due to moisture evaporation caused by thermal energy. Painting samples absorbed water at a rate of 0.8 to 2.0 L per  $1.0 \text{ m}^2$  area of a painting per day. Evaporation was at a rate varied from 60 to 70 % of this absorption rate. It was found from obtained results that the paintings in porous support absorbed moisture from support and evaporated through the permeable areas in the paint layer called windows. Paintings on rock support absorbed moisture from air through windows and dispersed in the ground layer. Painting ground needs a minimal amount of water to upkeep its adhesion and cohesion; surface must evaporate moisture at a rate that prevents accumulation of moisture in the ground. A constant amount of moisture should be in the surface layer to prevent its thermal expansion. This amount is decided by the temperature and relative humidity of the chamber. From these observations, following factors were identified as parameters necessary for successful functioning of paintings: Painting ground must have adequate porosity and the paint layer must have the required area of windows to facilitate moisture absorption/evaporation and a prescribed constant amount of moisture to prevent thermal expansion. Design parameters of paintings are related to these three requirements. These design parameters are porosity, hence composition of ground; thickness of ground and relative area of windows in the paint layer. It was understood from the study that traditional artists paid their attention to following factors: production of painting grounds that absorb water rising in the support, provision of an adequate area of windows in the paint layer to absorb/evaporate relevant amount of moisture, prevention of accumulation of water in the ground, avoiding over-drying of ground and reducing surface movement by controlling the amount of moisture in the surface layer.

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## SECTION D

401/D

### Effect of some inhibitory substances on fermentation of sweet sugary sap of Coconut

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The main source of crude sugar in Sri Lanka is the sweet sugary sap obtained from the tapped inflorescence of the Coconut (*Cocos nucifera*), Palmyrah (*Borassus flabellifer*) and Kith (*Caryota urens*) palms. This sap is sterile and highly charged with sugar, but unless special precautions are taken, fermentation by yeast and bacteria leads to accumulation of alcohol and acids. Lining the inside of the pot with fresh lime, placing Hal bark (*Vateria copallifera*), Kahata bark (*Careya arborea*), leaves of Ankenda (*Achronychia laurifolia*) and the leaves of Kohomba (*Azadiracta indica*) in a clean pot before it is used for collecting sap, are the most common methods used to reduce fermentation. The objective of the study was to study the effect of various substances used, to prevent fermentation taking place in the Coconut sap and to recommend the cheapest and easily available, efficient fermentation preventing substance.

Pieces of fresh bark of Hal, Kahata and leaves of Kohomba at the same rate (weight -100g / pot) were put into each collecting pot before use. Another pot was lined with lime. Control was also maintained with out any materials. The samples of sap were collected at equal time intervals and analyzed for reducing sugars, total sugars, pH, alcohol, number of yeast and bacterial cells. The pH of Coconut sap in Hal, Kahata, Kohomba and control showed significant difference separately with the pH values in Lime ( $t = 0.05$ ). The pH was very high (12 -13) in lime and remained the same throughout the experiment. Bacterial cells (in order of  $10^7 - 10^8$  cells / mL) were found after 15 hours in all the treatments except in the one with lime. Number of bacterial cells was very much lower initially and the growth rate gradually decreased with the time. Kahata and Kohomba also showed decrease in the bacterial population. Yeast cells were found in almost all treatments except lime. In Hal, yeast cells were very much lower initially but increased towards the end. In other treatments yeast showed a slightly slower growth rate when compared with the control. No alcohol was found in the limed pot. Hal and Kohomba showed significantly lower percentage reduction in the amount of sugar as compared to that of control. Lime is the most effective, cheapest and easily available substance that prevents fermentation taking place in the sweet sugary sap of Coconut. Hal could be used as effectively as lime to preserve sweet toddy of Coconut, for 45 hours. Due to the difficulties in getting Hal bark and Kahata bark all over in Sri Lanka they are not recommended. Kohomba is also not recommended because of its poor ability to inhibit fermentation.

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402/D

### Distribution of Lobariaceae (a lichen family) within the Horton Plains National Park

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The lichen family Lobariaceae has four genera including *Dendriscoaulon*, *Lobaria*, *Pseudocyphellaria* and *Sticta* and 300 species occurring on various substrata. It is widely distributed in both temperate and tropical regions and especially well developed in rainforest biomes. In Sri Lanka, 7 species of *Lobaria*, 4 species of *Pseudocyphellaria*, 11 species of *Sticta* and none of the *Dendriscoaulon* have been recorded in the past. Lichens of family Lobariaceae are widely used as indicators of ecological continuity. The objective of this study is to investigate the diversity of family Lobariaceae in selected plots within the Horton Plains National Park (HPNP).

Lobariaceae flora found on bark of trees (dbh  $\geq$  5 cm) up to 2 m from the ground level in ten selected sites within the HPNP were studied. Data on each species composition, its abundance and frequency were noted in one third of the host trees present in each plot.

A total number of 396 specimens of Lobariaceae belonging to 3 genera and 27 species were identified. Out of them 4 species belonged to the genus *Lobaria*, 7 to *Pseudocyphellaria* and 16 to *Sticta*. There were no new records of *Lobaria*, however, 2 unidentified species were found. Four species of *Pseudocyphellaria* (*P. desfontainii*, *P. sayeri*, *P. beccarii* & *P. dissimilis*) were found to be new records to Sri Lanka. In the genus *Sticta*, 2 species (*S. duplombata* & *S. subtomentella*) were new records and 10 species were unidentified.

*P. beccarii* had the highest cover value (7365.40 cm<sup>2</sup>), while *L. retigera* was the second highest (2915.65 cm<sup>2</sup>). *Sticta* sp. 4 (unidentified) showed the lowest cover value (2.30 cm<sup>2</sup>) for the study area. According to the frequency of lichens of Lobariaceae, genus *Sticta* and genus *Pseudocyphellaria* were the predominant genera, while genus *Lobaria* was the dominant. There were no genera found to be common, rare or very rare. However, in the specie level, *P. beccarii* and *P. intricate* were the dominant species of Lobariaceae. Also *Lobaria* sp. 1, *P. dissimilis*, *S. duplombata*, *S. subtomentella*, *Sticta* sp. 2,3,4,5,6,7 and 9 were found to be very rare. The presence of *P. beccarii* and *S. cyphellulata* in all the studied sites and the absence of genus *Dendriscoaulon* in all the sites were also observed.

The knowledge in diversity of family Lobariaceae will be useful in predicting the ecological continuity of the Horton Plains National Park.

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403/D

### **Management of collar rot of *Capsicum annuum* caused by *Sclerotium rolfsii* through *Trichoderma harzianum***

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Saprophytic microorganisms are common inhabitants of plant surfaces. By various mechanisms, they may alter the growth of pathogens and reduce the diseases they cause. Growing awareness of the environmental damage caused by the use of chemical substances for plant disease control in agriculture has raised the need to study biological alternatives. Biological control involves harnessing disease suppressive microorganisms to improve plant health. *Sclerotium rolfsii* Sacc. is a widespread phytopathogenic fungus affecting a large number of crop plants leading a considerable crop loss. It causes collar and root rot on *Capsicum annuum* and one of the important soil-borne pathogens in Sri

Lanka. An isolate of *Trichoderma harzianum* was selected on the basis of antagonism showed against *S. rolfii* in dual Petri plate assay. In the Petri plate assay, *T. harzianum* inhibits the growth of *S. rolfii* showing a clear inhibition zone between two fungi and sclerotia formation did not take place compared to the control plates. Moreover, *T. harzianum* coiled around the *S. rolfii* and disintegration of the pathogen's hyphae was observed indicating strong antagonism activity of the biocontrol agent. The isolate reduced disease incidence significantly when delivered as soil amendment at the rate of  $10^6$  conidia/ g soil but not used as seed dressing in the pot trials. Combined application significantly enhanced the plant protection compared to the single application. The results implicated the importance of mode of application of the biocontrol agent and the effectiveness of *T. harzianum* in controlling *S. rolfii* on *C. annuum*.

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**404/D**

***Trichoderma harzianum* mediated induced systemic resistance (ISR) in bean against bean rust**

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*Trichoderma* spp. are effective biocontrol agents for a number of soil-borne pathogens, and some are known for their ability to enhance plant growth. It was recently suggested that some strains of *Trichoderma* also trigger induced systemic resistance (ISR) in plants. The ability of a *Trichoderma harzianum* to protect bean plants against *Uromyces appendiculatus*, the causal agent of bean rust, under greenhouse conditions was studied. The fungal biocontrol agent was introduced to the plants through seed microbiolization or inoculated directly into the potting mix as a conidial suspension at the rate of  $10^6$  conidia/ ml. Treatment of non-microbiolized seeds and non-inoculated soil were included as controls and synthetic resistance inducer salicylic acid was also used. Treated seeds resulted in reduced disease severity as assessed by detached leaf assay compared with the control treatment in fourteen days old bean plants. Disease resistance was not observed in 14-days old plants grown in soil inoculated treatment. However, 21-days old primary leaves were equally resistant to the pathogen despite the mode of application of the biocontrol agent. Since the resistant inducing agent and challenging pathogen was spatially separated the state of resistant observed on primary leaves should be attributed to induced systemic resistance.

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**405/D**

**Preliminary study of insecticidal activity of *Bacillus thuringiensis* formulation against cabbage pest complex**

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*Bacillus thuringiensis* (*Bt*) is the one of the most widely used environment friendly alternative to synthetic insecticides for the biological control of agricultural, forest pests and vectors of human and animal diseases. During sporulation, *Bt* produce crystalline parasporal inclusion bodies, composed of

toxic proteins known as  $\delta$ -endotoxins, with a high level of specificity against lepidopteron, dipteran, and coleopteran insects and certain parasitic nematodes. The objective of the present study is to evaluate the field efficacy of the Sri Lankan isolate of *Bt* for cabbage pests.

*Bacillus thuringiensis* was isolated from Sri Lankan environmental soil and mass cultured by liquid fermentation. Field experiments were conducted at Thalathuoya in Kandy during November – February season. Four week aged healthy seedlings of cabbage raised in a nursery were transplanted on 3x1.5 m<sup>2</sup> plots at a spacing of 30x30 cm<sup>2</sup>. Standard agronomic practices were carried out through out the experiment. Field applicable concentration of *Bt* was suggested as 10<sup>7</sup> spores/mL based on the data obtained at laboratory experiment. Application rates of commercial Spinosad were determined according to the information given in the product. Four replicates were carried out.

*Bacillus thuringiensis* formulation having the spore concentration of 4 x 10<sup>7</sup> spores/ mL showed 33% and 41% population reduction of diamondback moth (DBM) and semilooper larvae 10 days after treatment, respectively. Commercial Spinosad formulation having concentration of 400  $\mu$ L/L gave 98 % and 75 % population reduction of cabbage semilooper and DBM respectively 10 days after treatment. Population densities of DBM moth and semilooper in control treatment plot were increased rapidly.

The results suggest that the higher spore concentrations are needed in the *Bt* formulations to reduce the DBM and semilooper populations effectively under field conditions. Commercial Spinosad formulation showed significant reduction in both DBM and semilooper populations as it only contain the concentrated natural toxins, Spinosyn A and D. This study showed that *Bt* formulation could be used as useful bio-control agent against cabbage pests, DBM and semilooper.

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**406/D**

### **Control of *Colletotrichum* species – causative agents of *Colletotrichum* leaf disease of rubber**

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Among the foliar diseases of rubber *Colletotrichum* Leaf Disease (CLD) is considered as one of the major causes of declining yields of rubber in the Asian continent. The pathogen *Colletotrichum gloeosporioides* has been considered to be the causative agent of this disease in early 1900's in all rubber-growing countries in the world. However, observations of a more recent survey performed in Sri Lanka revealed that the fungus *Colletotrichum acutatum* also plays a significant role in the development of CLD in rubber plantations of Sri Lanka. Due to the yield loss incurred by the disease, development of methods to control the organisms is of great importance. Therefore, *in-vitro* investigations were carried out to identify the most suitable fungicide for managing both *Colletotrichum* species pathogenic to rubber. A range of concentrations of three fungicides namely copper oxychloride (Cobox, 50% a.i, BASF), hexaconazole (Contaf, 5EC, Bayer) and tebuconazole (Folicur, 250 EC, Bayer) were screened employing two screening techniques; conidial germination inhibition technique [CGIT] and poisoned food technique [PFT] to evaluate respectively, the efficacy of inhibiting conidial germination and mycelial growth. Fungicides hexaconazole and tebuconazole were identified as effective fungicides in controlling mycelial growth and spore germination of *Colletotrichum* species, as both these species are responsible in causing CLD in Sri Lanka. The fungicide hexaconazole was most effective in controlling the mycelial growth of *Colletotrichum*

*acutatum* and *Colletotrichum gloeosporioides* at markedly low concentrations of 5 µgml<sup>-1</sup> and 10 µgml<sup>-1</sup> respectively and the germination of conidia of both species was inhibited by hexaconazole at 10 µgml<sup>-1</sup> and 20 µgml<sup>-1</sup> respectively.

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407/D

### Taxonomical identification of *Ratalawulu* – *Pouteria campechiana* Sapotaceae

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There is controversy regarding the identity of the yellow *lavalu* in Sri Lanka. It has been confirmed by taxonomical studies that this *lavalu* is *Pouteria campechiana* (Sinhala: *Ratalawulu*). This is the only yellow *lavalu* (*ratalawulu*) found in Sri Lanka. Samples were collected from, Kadawata, Kurunegala, Makola, Maharagama, Nawala and Peradeniya (Yamaha, Colombo, Kurunegala and Kandy districts) Plant specimens were examined for venation, shape and margin of leaf, characteristics of fruit and inflorescence and compared with data of Verdcourt and Meijer, Barlow as well as specimens in the National Herbarium, Peradeniya by a phytotaxonomist. Past studies identified *ratalawulu* specimens as that of *Chrysophyllum roxburghii*, however descriptions of the fruit and photographs do not match this identification. The fruit pulp of *Chrysophyllum roxburghii* is white in colour and has negligible carotenoid content. The fruits collected for analysis in this study represent by far, the most common home garden *lavalu* in Sri Lanka, which according to Verdcourt and Meijer is called *ratalawulu*, has 1-6 seeds and was introduced to Sri Lanka from Central or South America.

Table 1: Leaf characteristics to differentiate plants collected from *Chrysophyllum roxburghii*

Characteristic	Plant collected ( <i>Pouteria campechiana</i> )	<i>Chrysophyllum roxburghii</i>
Simple/compound	Simple	Simple
Shape	Oblanceolate; length: 10 – 22.5 cm; width: 2.5-6.6	Elliptic; length: 7.5-12.5cm; width: 2.5-3.3 cm
Base	Acute; sides even	Acute; sides uneven
Apex	Cuspidate	Short cuspidate
Margin	Entire	Broadly wavy
Venation	Pinnate; ~ 1 cm between veins; 11-21 veins; Veins prominent on lower surface	Pinnate; closely veined; ~0.5 cm between veins; 12-25 veins; veins prominent on lower surface
Arrangement	Alternate	Alternate
Attachment	Petiolate; Petiole 1.5-3 cm	Petiolate; petiole ~0.5 cm
Inflorescence	Up to 5 flowers*; 0.8 – 0.9mm in length; 0.5 – 0.7mm in width	> 20 flowers*; ~1mm in length; ~ 1mm in diameter

\*Characteristics regarding flowers corresponded to that of Verdcourt and Meijer, 1995)

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408/D

### Air quality monitoring potential of corticolous lichens in tropical environment

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In this study, thirty-one sites located on six transects radiating from Colombo Fort were selected to investigate air quality monitoring potential of lichens. Six trees belonging to three species, (*Cocos nucifera*, *Mangifera indica* and *Artocarpus hetrophyllus*) and two more trees belonging to any other species were used at each site of 1km<sup>2</sup> area to monitor diversity and distribution of corticolous lichens. Coverage and frequency of lichens were recorded by placing 250cm<sup>2</sup> (25cm X 10cm) quadrat randomly at four places on the bole of each tree. All lichen species found within the grid, number of individuals of each species and the number of grid units in which a particular species recorded were estimated. Samples of lichens collected were identified using their morphology, anatomy, chemistry and reproductive characters. Lichen diversity of each site was determined using Shannon's diversity index. Using frequency or percentage cover of lichens and a factor of tolerance of toxicity given by ecological index (i.e. the average number of species, which coexisted with each species), the Index of Atmospheric Purity was calculated for every site according to the following formula, where n= Number of species recorded. Q = Ecological index (average number of species, which coexisted with each species), f = Cover or frequency of each species. 
$$IAP = \sum_{i=1}^n (Q \times f) / 10$$

Ambient SO<sub>2</sub> and NO<sub>2</sub> at each site were monitored using passive samplers. Land use pattern, traffic density, pH of substrates, and exposure of trees to light were also recorded. Data were statistically analyzed using mean comparison, correlation and by principal component analysis. IAP values of sites increased along all transects when moving from the city to suburbs indicating better air quality. Correspondingly, ambient SO<sub>2</sub> and NO<sub>2</sub> concentrations gradually decreased in sites from city to suburbs during the same period. Highest SO<sub>2</sub> (48.35 µg/m<sup>3</sup>) and NO<sub>2</sub> (42.82 µg/m<sup>3</sup>) levels were recorded from Fort. Relationship between diversity of lichens and levels of SO<sub>2</sub> and NO<sub>2</sub> was negatively correlated. Principle component analysis revealed that principal components, PC1, PC2 and PC 3 explained 38%, 20% and 15% of the total variation in data set respectively. Biplot developed by PC1 vs. PC2 revealed that low lichen diversity class separated from other classes due to increased concentration of SO<sub>2</sub> and NO<sub>2</sub>, land use pattern and traffic density all of which are included in PC1. It could be concluded that lichens of the tropics have the potential to be used in air pollution monitoring and IAP method is valid for tropics as well.

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409/D

### A microbiological study of some well water quality parameters with reference to the garbage dumping site at Navinna area

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Navinna dumping site is one of the well known waste dumping areas situated in suburbs of Colombo. Huge amounts of garbage increases day by day threatening the water sources in the area. Therefore the present study was carried out to determine the microbiological, physical and chemical parameters of well water around the Navinna waste dumping area. Fifty seven locations including fifty ground

water wells and seven permanent water pools were sampled at distance between 0-30m, 31-60m, 61-90m, 91-120m, 121-150m and <150m from the dumping site twice a month for a period of seven months from July 2006 to January 2007.

A pH range of (6.5-7.5); conductivity (144-161 $\mu\text{scm}^{-1}$ ); BOD<sub>5</sub> (1.44 -3.82  $\text{Omg l}^{-1}\text{day}^{-1}$ ); nitrate (0.06 - 1.47 $\mu\text{g l}^{-1}$ ); phosphate (122 – 372  $\mu\text{g l}^{-1}$ ) were detected within the drinking water standards given by Board of Investment, Sri Lanka. Reducing trend of the number of total coliform, *Escherichia coli* and viable bacteria were recorded with increasing distance from the dumping site. Total coliform ranged between 4-2400 MPN 100ml<sup>-1</sup> and high density was recorded 2400 MPN 100ml<sup>-1</sup> at the distance between 0-30m. A significant correlation ( $p < 0.04$ ) was found between total coliform counts with distance. Hundred percent of wells within the distance between 0-30m from the dumping site were contaminated with fecal coliform (*E. coli*) bacteria and the contamination % decreased with increasing distance. *E. coli* was not detected when the distance exceeds more than 150m from the dumping site. According to the water quality standards given by BOI, all the wells monitored were contaminated with coliform bacteria (MPN  $\geq 4$  100ml<sup>-1</sup>; BOI standards for coliform is 0 per 100ml) and of 49 out of 57 wells within 150m from the dumping site were contaminated with fecal coliform (87%) and undetectable when the distance exceeds more than 150m. Thus, the results of the present study revealed that the wells within 150m distance from dumping site were contaminated with fecal coliform and this may cause serious health problems. Therefore the responsible authorities should take immediate action to provide safe drinking water for the community of the study area.

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410/D

### **An Investigation of the effect of left over “food waste” on composting**

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The study investigated the effect of “food waste” as the major component of garbage on composting, using nine composting bins issued by the Central Environmental Authority, Baththaramulla, Sri Lanka (CEA). The investigation included three treatments named; “treatment pre” (only “pre cooked food waste”), “treatment post” (only “post cooked food waste”) and “treatment mix” (“pre cooked food waste” and “post cooked food waste” was used in 1:1 ratio). Leaf litter was used as supplement material for all the three treatments.

Several physiochemical and biological parameters of each treatment were recorded both on a daily and weekly basis. As daily parameters temperature, pH variations were studied, which weekly parameters were the total Carbon, organic Carbon and organic matter, ash and moisture contents while as the biological parameter insect larval densities were measured.

During the study period the highest temperature values and highest larval densities of *Hermetic* species (Family: Stratimyidae, Order: Diptera) were found most abundantly in “treatment post”, then in “treatment mix” and least in “treatment pre”, respectively. This is an indication that the composting process happens most efficiently in “treatment post”, then in “treatment mix” and in “treatment pre”. The pH values were significantly different between each treatment and tended to stabilize at 6.8, with time, but never came to 7.0, which is the value of fully matured compost.

The results indicate that, after 63 days, there were compost produced in all three treatments and showed that, leftover “food waste” has a significant effect on the composting process, which the

process happens most efficiently in “treatment post”, then in “treatment mix” and in “treatment pre”. Considering all above factors, it is better to dump “post cooked food waste” alone or by mixing with “pre cooked food waste”, rather than dump “pre cooked food waste” alone.

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411/D

### Degradation of *Cyanobacterium microcystis aeruginosa* by predacious protozoa

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Field and laboratory studies were conducted to investigate the algicidal effect of protozoa on regulation of *Microcystis aeruginosa* in Beira Lake for a period of ten months from May 2006 to February 2007. Modified algal lawn method was used to isolate algicidal protozoa from lake water and their grazing effect on *M. aeruginosa* was studied. *M. aeruginosa* was the dominant phytoplankton among the phytoplanktons recorded in Beira Lake during the study period. The cell density of *M. aeruginosa* was low until July 29 ( $2 \times 10^4$  cells ml<sup>-1</sup>) and then increased from 14 August ( $7 \times 10^5$  cells ml<sup>-1</sup>) to 30 of September ( $2 \times 10^7$  cells ml<sup>-1</sup>) and thereafter decreased sharply to 14 October and remained with fluctuation from November onwards. Densities of the *Polytomella* sp showed a gradual increase with fluctuation from 08 May to 03 September and then much higher showing a sharp peak on 30 September  $2 \times 10^3$  cells ml<sup>-1</sup>. Thereafter they decreased sharply to 04 November ( $3 \times 10^2$  cells ml<sup>-1</sup>) and then maintained the cell density around  $2 \times 10^2$  cells ml<sup>-1</sup> until 17 December. From 07 January onwards the cell density of *Polytomella* species was undetectable. A coupled oscillation between the *Polytomella* sp and *M. aeruginosa* bloom in a hypereutrophic lake and a negative relationship between *M. aeruginosa* and the grazing *Polytomella* sp were reported during the collapse of diatom and *M. aeruginosa* blooms in UK and Japan respectively. The significant correlation between *M. aeruginosa* and grazing effect of the *Polytomella* species in Beira Lake (84%) was found in the present study. The grazing effect of *Polytomella* species on *M. aeruginosa* was confirmed by in the laboratory study with ( $r^2 = 22\%$ ) and without ( $r^2 = 50\%$ ) eukaryotic inhibitor cycloheximide. Thus the results of the present study suggest a algicidal effect of the *Polytomella* species on *M. aeruginosa*. Loss rate of *M. aeruginosa* due to grazing effect of *Polytomella* species was studied and Considerable decline in the abundance of *M. aeruginosa* was detected with in 12 hours ( $0.02 \text{ hr}^{-1}$ ). The high loss rate of *M. aeruginosa* was resulted when the growth rate of *Polytomella* species was high ( $0.113 \text{ hr}^{-1}$ ). Thus, the present laboratory and field studies report that the flagellate *Polytomella* species plays an important role in regulating *M. aeruginosa*. Further ecological studies of the agent *Polytomella* species and *M. aeruginosa* are required.

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412/D

### Avifaunal species richness and diversity at the premises of the University of Sri Jayawardenepura, Nugegoda, Sri Lanka

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Diurnal Avifaunal species richness and the species diversity at the University of Sri Jayewardenepura, Nugegoda, Sri Lanka was recorded using fixed radius point count method from August 2004 to March 2005. Seven circular plots with a 50m radius and their centers at least 150m apart were selected to represent all the habitat types available at the University. Avifaunal populations in these seven plots were recorded from 6:00 hrs to 9:00 hrs, four times each month. Thirty two bird species belonging to eight orders and twenty three families were recorded during the study period. These included three migratory bird species, Forest wagtail (*Dendronanthus indicus*), Asian paradise-flycatcher (*Terpsiphone paradisi*), Grey wagtail (*Motacilla cinerea*) and one endemic species Crimson-fronted barbet (*Megalaima rubricapilla rubricapilla*). Three bird species, Rose ringed parakeet (*Psittacula krameri*), Red vented bulbul (*Pycnonotus cafer cafer*) and Yellow billed babbler (*Turdoides affinis taprobanus*) were recorded in all seven sites. Endemic Crimson fronted barbet was recorded only in the site, which had large trees. Seventeen avian species were recorded in all the months from August 2004 to March 2005. There was no significant difference of the species richness among months. Site with *Casuarina equisetifolis* had the highest species richness of 25 and site covered with grass had the lowest species richness of 11. Relative abundance indicated that Common myna was the most common bird followed by the Red-vented bulbul. Long-billed sunbird and Indian pond heron were the least common birds followed by Oriental white-eye and Crimson-fronted barbet. Although the University is situated 2 km away from the well known aquatic bird sanctuary, Bellanwila – Attidiya marsh, no aquatic birds were recorded. The University provides habitats for thirty two avian species despite the fact that it is situated in a highly urbanized area, and thus warrants step to protect them.

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413/D

#### **Phenetic relationships of natural and cultivated *Cinnamomum verum* J.Presl. Accessions of Sri Lanka**

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*Cinnamomum verum* is well known as a spice tree. The Cinnamon Research Station possess several *C. verum* accessions where ten different groups have been identified based on leaf morphological characters. These groups were further defined based on their oils properties. Therefore, the present study was undertaken to determine the morphological difference of these accessions in order to evaluate their phenetic relationship with naturally occurring *C. verum*.

Morphological characters were studied in detail. Phenetic analyses were carried out using the statistical packages MINITAB 13.2 and PC-ORD version 4.

Based on the dendrogram, two distinct clusters were identified, where the wild *C. verum* with two accessions grouped together. These two accessions further showed a variation from *C. verum*. The other cluster further divides into two, separating accessions 1 and 3, early and few others, which could also be supported with additional characters. Two accession do not show any morphological difference

Based on the results of the of the phenetic analyses using morphological data, of the ten accessions that are possessed by the Cinnamon Research Station, that have been collected from wild, only two

accessions are morphologically close to *C. verum* while the other eight accessions show several morphological characters that are different from *C. verum*.

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414/D

### Antioxidant properties of leafy vegetables consumed by Sri Lankans

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The present study reports the antioxidant properties (content of total phenols, flavonoids, ascorbic acid, reducing power, DPPH<sup>·</sup> radical scavenging activity, antioxidant activity measured using molybdenum) of six varieties of leafy vegetables consumed by Sri Lankans namely *Ipomoea aquatica* (Sinh. Kankun), *Centella asiatica* (Sinh. Gotukola), *Alternanthera sessilis* (Sinh. Mukunuwenna) and the non conventional leafy vegetables *Cardiospermum halicacabum* (Sinh. Penela), *Passiflora edulis* (Sinh. Passion fruit) and *Lasia spinosa* (Sinh. Kohila).

Content of total phenols and free phenols were determined for aqueous and methanol extracts using Folin Ciocalteu reagent. The free flavonoid content was determined using AlCl<sub>3</sub> and the ascorbic acid using 2, 6-dichlorophenolindophenol method. Reducing power of potassium ferricyanide, free radical scavenging power by DPPH<sup>·</sup> radical and total antioxidant activity using Mo (VI) were also determined. The results were subjected to statistical analysis by one way ANOVA.

The present study revealed that methanol is the best solvent for the extraction of phenols and flavonoids. Total phenols in aqueous extract of *A. sessilis* (3.04±0.27 g/100 g) was the highest while in the methanol extracts the highest was in *L. spinosa* (3.30 ± 0.25 g/100 g). *C. asiatica* is the best source of flavonoids while *C. halicacubum* is the poorest source. Ascorbic acid content ranged from 2631 (*P. edulis*) - 49 (*A. sessilis*) mg/100g (DW) for fresh leaves and 136 (*P. edulis*) – 27 (*A. sessilis*) mg/100 g for freeze dried leaves. *L. spinosa* had the highest reducing power while *A. sessilis* had the lowest. The reducing power was not directly related to the individual content of phenols, flavonoids and ascorbic acid. Total antioxidant activity deduced by the reduction of Mo (V) indicated that *L. spinosa* (2482 ± 536 mg/100 g) had the highest antioxidant activity while *C. asiatica* (384 ± 177 mg/100 g) had the lowest activity. Free radical scavenging activity determined using EC<sub>50</sub> for DPPH<sup>·</sup> indicated that *A. sessilis* had the lowest scavenging power while highest was observed with *I. aquatica* and *C. asiatica*. The result of this study indicated that the flavonoids, phenol and ascorbic acid does not bear a direct relation to the antioxidant activity and the reducing power and the synergistic effect of these compounds have to be considered in deducing the antioxidant activity. The present study indicates that *I. aquatica* is a good source of antioxidants.

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415/D

**Taxonomic position of *Mesua stylosa* (Thw.) Kosterm. (Clusiaceae)  
- A morphological and anatomical approach**

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Thwaites in 1858, initially recognized *Kayea stylosa* Thw. which was retained by both Thwaites, (1874) and Trimen (1893) in their respective taxonomic treatments for the genus. During the revision of the Flora of Ceylon, however, Kostermans (1980) synonymised *K. stylosa* under the genus *Mesua* as *M. stylosa* (Thw.) Kosterm. This new placement of *Kayea* has been questioned by a recent taxonomic study. The present study was undertaken to examine the taxonomic position of *M. stylosa* (Thw.) Kosterm. within the genus *Mesua* occurring in Sri Lanka, using anatomical and morphological characters. The generic treatment by Kostermans (1980) has been used as the base for this study. Morphological studies were carried out by studying live and herbarium specimens in detail for different vegetative and reproductive features. At least three specimens per species were studied. Leaf venation studies were carried out by clearing leaves and observing their patterns. Anatomical studies were carried out by obtaining microtome sections of wood and leaves.

The detailed morphological and anatomical studies of the different *Mesua* species recognized as occurring in Sri Lanka resulted in several variations among them separating *M. stylosa* from the rest of the *Mesua* species. It differed from the rest of the *Mesua* species by having the smallest leaves and flowers; raceme type inflorescence; numerous flowers in a terminal raceme; stalked flowers; subulate stigma; small fruits with fully enclosed by woody, enlarged sepals; randomly distributed pentagonal areoles; smallest number of sub-veins between two secondaries; solitary, rounded, diffuse porus vessel arrangements; broadly banded apotracheal axial parenchyma; heterogeneous multiseriate rays with uniseriate tail where the tail are shorter than the body of the ray cells; length of the multiseriate rays are variable and phloem occurs in the adaxial side of the leaf lamina.

The above distinct variations identified in *M. stylosa*, several of which are novel leaf and wood anatomical characters, support reverting its position under the genus *Kayea* and consequently resurrection of the species *K. stylosa* Thw.

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416/D

**Proximate composition of coconut flesh, first and second extraction of coconut milk**

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As Sri Lankans we consume more coconut per individual of any other coconut producing countries. Coconut palm (*Cocos nucifera*) has many uses especially in preparation of meals from the fruit kernel and milk extracted from the kernel. The present study was aimed at determining the proximate composition and sugar content of coconut flesh, first and second extracts of coconut milk of randomly selected coconut from three different areas (Kurunaegala, Matara and Colombo)(n=6) using standard methods. Coconut milk (1<sup>st</sup> and 2<sup>nd</sup>) extracts were prepared by hand-squeezing the grated coconut with distilled water (coconut: water = 1:0.5) respectively.

When considering the coconut flesh, the moisture, ash and total dietary fibre contents were  $49.2 \pm 6.3\%$ ,  $1.7 \pm 0.7\%$  and  $36.9 \pm 1.2\%$  respectively. The most significant nutrient, fat was  $55.6 \pm 5.3\%$  followed by insoluble dietary fibre content of  $27.2 \pm 4.1\%$ . Soluble dietary fibre was one third of insoluble dietary fibre ( $9.7 \pm 4.2\%$ ). Sucrose content was  $1 \pm 0.4\%$  from total reducing sugar ( $3.8 \pm 0.2\%$ ) content of coconut flesh.

In the case of both coconut milks the major contribution was from fat with the first extraction having double the amount of fat ( $81.2 \pm 7.0\%$ ) than the second extraction ( $34.6 \pm 5.3\%$ ). The insoluble dietary fibre contents were  $10.6 \pm 5.9\%$  and  $1.4 \pm 1.1\%$  in first and second milk extracts respectively. Both extracts had similar soluble dietary fibre contents ( $3.4 \pm 1.8$ ,  $3.1 \pm 1.9$ ). Of the total insoluble fibre an average range of 35% had been extracted into the first milk and only 9% into the second milk. Likewise the total soluble dietary fibre extracted into first and second milk extracts were 34% and 31% respectively. Total reducing sugar contents were significantly ( $p < 0.05$ ) high in the second extract ( $5.1 \pm 0.5\%$ ) of the coconut milk when compared to the first extract ( $3.3 \pm 0.3\%$ ). The second extract also contained higher sucrose ( $2.8 \pm 0.6\%$ ) than the first extract ( $1.7 \pm 0.6\%$ ) even though not significant. The first extract had significantly high fat and insoluble dietary fibre than the second extract.

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417/D

### 'Tel olu' – is it really an 'Olu' ?

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The genus *Nymphaea* L. includes two species in Sri Lanka, *N. nouchali* Burm. f. and *N. pubescens* Willd. and are commonly known by the vernacular names, 'Manel' and 'Et-olu' or 'Olu' respectively. Apart from these two commonly known *Nymphaea* species, another group exists by the vernacular name 'Tel-olu' which has not been recorded in literature. The field experiences also proclaimed the occurrence of several morphological variants with very distinct character combinations that is not listed under the presently recognized species descriptions. Therefore, a phenetic analyses of morphological and anatomical data was undertaken to evaluate the existence of any other species of *Nymphaea* in Sri Lanka.

Live plant materials of *Nymphaea* species including 'Tel-olu' were collected from all possible areas from different populations. Characters and character states were coded into a data matrix using Excel computer package. Multivariate methods of analysis, Cluster Analysis and Principal Component Analysis were carried out using the statistical packages MINITAB 13.2 and PC-ORD version 4. All the resulting dendrograms initially identified two clusters, one corresponding to 'Olu' and the other including 'Manel' and 'Tel-olu'. This later cluster further divided into two groups, where the 'Tel-olu' group clearly separated from 'Manel'. Several distinct features could be identified to separate 'Tel-olu' from 'Manel'. These characters include the leaf size, color of leaf abaxial and adaxial surface, the thickness of leaves, petiole color, and shape of petals and sepals. The flower color distribution between the groups were interesting where the white–light blue flowers always occurred in 'Tel-olu' whereas the violet (purple) color always occurred in 'Manel'.

Based on the present study, *Nymphaea* species that is commonly known by the vernacular name 'Tel-olu' is not an 'Olu' species but a 'Manel'. Further the 'Tel-olu' showed several distinct morphological features separating from 'Manel'. Therefore, the study confirms the presence of an additional *Nymphaea* species in Sri Lanka, which needs further studies in confirming the identity.

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**418/D**

### **The hypocholesterolaemic effect of *Canthium Coromandelicum* leaf on Wistar rats**

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The *Canthium coromandelicum* leaf (Sinhala Kara) is consumed locally and advocated by some Ayurvedic practitioners as being suitable for lowering hypertension. The leaf is found to contain 3.0 to 7.6% soluble dietary fibre (SDF) on dry weight basis and 21.0 to 45.2% of SDF was found to be pectin. Pectin was found on Sepharose (2B) gel chromatography to be of very high molecular weight, up to 2 million Daltons with Mode, Mean and Median (10.0ml, 11.3ml and 12.0ml) showing M.W. higher than even Palmyrah fruit pulp (Mode-14ml, Mean-14.2ml and Median-14ml). On feeding the leaf (20g fresh leaves/kg B.Wt. /day) compounded into WHO animal feed to Wistar rats (n=6, for each group) in a diet which was isocaloric and having the same insoluble fibre contents as control it was found that the food intake per day was similar in test and control groups (14.8g and 14.0g). The test diet was adjusted for dietary fibre by replacing grass powder with leaf powder and polished rice in place of brown rice. However, the weight gain in the test group reduced significantly by 14.6% (p=0.028) after 34 days and was reduced up to 25.3% after 7 weeks. Serum cholesterol content declined significantly by 24.8 % (p=0.049) in the test group in a period of 7 weeks. A further 4 weeks of feeding on SDF isolated from the same quantity of leaves maintained the significant decline in serum total cholesterol levels (p=0.025) showing that pectin is the active component, confirming the previous reports on other plant materials that high molecular weight pectin results in significant lowering of total serum cholesterol.

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**419/D**

### **A preliminary investigation on desalination function of mangrove plants**

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This study was conducted to identify the desalination potential of mangrove species. The study carried out with mangrove plant samples collected from Kirinda, Rakawa and Kalametiya in Hambanthota District. Mangrove species found at study sites were *Avicennia marina*, *Lumnitzera racemosa*, *Aegiceras corniculata* and *Exoecaria agallocha* (Kirinda), *Avicennia marina*, *Lumnitzera racemosa* (Kalametiya) and *Avicennia officinalis*, *Ceriops tagal* (Rakawa). Desalination of sediment by

mangrove species was measured by calculating the percentage NaCl content in samples of leaves and sediment in vicinity. Sediment samples were obtained from 0m, 1/2m and 1m distance from the same tree from which leaf-samples were collected. Percentage NaCl content in samples of leaves and sediment were measured by using aqueous extractions of leaves and sediments and titrating them with 0.01 AgNO<sub>3</sub> in the presence of potassium thiocyanate as an indicator. According to results, mature leaves of *Avicennia marina*, contain relatively high percentage of NaCl content (7.42 %). Percentage NaCl content in sediments taken from the vicinity of *A. marina* trees increased gradually with distance from the plants. *A. marina* is a salt secretor, which absorbs relatively a high amount of salt from the substratum than that of salt non- secretors. Hence this investigation identified *A. marina* as the best mangrove species capable of desalination of mangrove soils.

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#### 420/D

##### **Prevalence of Paramphistomiasis in buffaloes reared in a farm and a village house in Matara District**

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Paramphistomiasis is a disease found in Sri Lanka's large ruminants husbandry, which cause economic losses by mortality, reduced growth rates and working capacity, low milk production and low productivity. According to the veterinary office, Department of Animal Production and Health, Paramphistomiasis is commonly found among buffaloes in the Matara district. The present study focused on the study of the prevalence of Paramphistomiasis in two selected sites in the Matara district; a semi-intensive farm situated in a suburban area of Matara and the other site in a village area where buffaloes are managed by extensive farming. Objectives of the study were, to compare the total prevalence of paramphistomiasis between farm reared buffaloes and buffaloes reared in the village; to compare the prevalence of the disease among age groups within each site and between sites; and to determine whether there is a relationship between the prevalence of the disease and the intermediate host population (snail) density and frequency.

Faecal samples of fifty-one farm reared buffaloes and thirty-nine of village reared buffaloes were examined by sedimentation technique. EPG values (eggs per gram) and infection prevalence were obtained. Snail sampling was carried out in grazing and drinking areas of buffaloes in both sites by a belt transect method using a 30 cm<sup>2</sup> quadrat. All the snail species obtained from sampling sites were identified using standard keys, and number of *Indoplanorbis* (intermediate host) in each quadrat was counted and their density and frequency determined.

Overall EPG values of the two rearing systems were not significantly different ( $P = 0.438$ ). With the exception of the 1-3 y age groups ( $P = 0.01$ ) between the two rearing systems, there was no significant difference between EPG in age groups in the two sites. Considering the EPG values among age groups, within a site, significant differences were found only between age groups 1-3 y and 3-5 y in both rearing systems (farm reared buffaloes,  $P = 0.015$  and village house reared buffaloes,  $P = 0.003$ ). Overall infection prevalence in farm reared buffaloes and village reared buffaloes were 70.6% and 92.3%, respectively. Infection prevalence was significantly different ( $P < 0.05$ ) among age groups between sites while no significant difference ( $P > 0.05$ ) was found among age groups within the same site. There were no significant differences of molluscan density between the

two sites ( $P= 0.110$ ). A significant difference of molluscan frequency found between the two sites ( $P=0.025$ ) resulted in a higher prevalence paramphistomiasis in village reared buffaloes.

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421/D

### **Mineralization and release of inorganic nitrogen in soils amended with animal manure**

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Animal manures are generally assumed to provide a readily available source of nitrogen to crops. Information on the release of nitrogen and other nutrients from animal manure is vital to adopt crop nutrient management systems that minimize the use of chemical fertilizers and increase the productivity of soil. Mineralization and release of inorganic nitrogen was determined for three different animal manures in a laboratory incubation experiment. The soil used for the incubation was an Ultisol (Hapludults) with a loamy sand texture. Dried and ground manure of cattle, goat and poultry were allowed to decompose in soil for 12 weeks at the rate of 5 MT/ha (dry matter). A control soil treatment with no amendments was also included in the experiment for comparison. Soil was analyzed periodically for inorganic/available nitrogen ( $\text{NH}_4^+\text{-N}$  and  $\text{NO}_3^-\text{-N}$ ).

Application of animal manure influenced the amount of inorganic/available N in soil. The release of  $\text{NH}_4^+\text{-N}$  was high at the start of the incubation in all treatments and gradually decreased with the incubation period. The highest  $\text{NH}_4^+\text{-N}$  content, on average, was observed in the soil amended with poultry manure followed by goat and cattle manure/dung, respectively. Amount of  $\text{NH}_4^+\text{-N}$  in poultry manure amended soil ranged from 4 – 25 mg/kg soil while ranges for cattle and goat manure were 2 – 17 and 3 – 22 mg/kg soil, respectively. As expected, the control soil recorded a low level of  $\text{NH}_4^+\text{-N}$  (a range of 2 – 13 mg/kg soil) compared to manure amended soils.

In general, poultry manure amended soil recorded the highest  $\text{NO}_3^-\text{-N}$  content while the control soil recorded the lowest  $\text{NO}_3^-\text{-N}$  content at the end of the incubation period. Mineralization and release of nitrogen varied among animal manure used in the incubation and poultry manure had the highest and rapid release of nitrogen followed by goat and cattle manure/dung. The amount of  $\text{NO}_3^-\text{-N}$  in poultry manure amended soil ranged from 26 – 72 mg/kg soil while ranges for cattle and goat manure were 12 – 35 and 18 – 49 mg/kg soil, respectively. The control soil had a  $\text{NO}_3^-\text{-N}$  range of 13 – 17 mg/kg soil during the incubation. Results of this study indicate that animal manure is a good provider of N for crop growth and the release of nitrogen from different types of animal manure could be synchronized with crop growth to minimize the usage of chemical fertilizers and N losses from soil.  $\text{NO}_3^-\text{-N}$  in soil amended with animal manure increased up to 12 weeks of incubation indicating the continued mineralization and accumulation of  $\text{NO}_3^-\text{-N}$  in soil.

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422/D

### Cloning and characterization of glutelin B1 promoter from rice - towards the development of wheat-like rice

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Rice flour does not have dough-making properties and hence vast amount of foreign exchange is spent on importation of wheat for production of bread and other bakery products. Development of wheat-like rice would be beneficial as a substitute for wheat flour. Glutelin genes are selectively expressed in the rice endosperm. Thus, the glutelin promoter is an ideal candidate to drive seed specific expression of trans-genes in rice. The objective of this study was to clone the minimal glutelin B1 (Glu B1) promoter from two varieties of *Oryza sativa* subsp. *indica*. The Glu B1 promoter of Bg 300 and Bg 350 varieties were initially amplified by polymerase chain reaction (PCR) using a set of primers (F1-5'CTCAAGCATAAGACGTTTATG3' R1-5'CGCCATAGCTATTTGTTACTTC3') flanking the promoter region and followed by nested PCR (F2-5'GGGGAATTCACATA TTAAGAGTATGGACAGAC3', R2-5'GGGGGATCCTTAAGCTAATGATGGGTTC3') to amplify the minimal promoter of 262 bp. The PCR primers were designed based on the published Glu B1 promoter sequence of the *japonica* sub species. Single PCR-amplified products of the expected size were obtained for both *indica* rice varieties. Subsequently these fragments were cloned into pUC19 plasmid. Positive transformants were analyzed by colony PCR and Pvu II restriction digestion, which confirmed the presence of the Glu B1 promoter region. The PCR amplified fragment of Bg 300 was sequenced and a BLAST search was performed against the available sequences in the NCBI data base. This revealed approximately 82% sequence similarity to Glu B1 promoter sequence derived from *japonica* sub species. Further analysis of the obtained sequence revealed the presence of AACA, GCN4, PROL and ACGT motifs, which are conserved in many seed storage protein genes and are crucial for seed specific expression. These results indicate that the amplified sequence corresponds to the authentic Glu B1 promoter region from *Oryza sativa* subsp. *indica*. This cloned Glu B1 promoter will be used in a subsequent study to develop an expression vector to drive endosperm specific expression of wheat glutenin and gliadin trans genes in rice.

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423/D

### Environmental impact on groundwater quality in Matara town area

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The study was conducted in the Matara town area which is bound by latitudes 5.56°633' and 5.57°603'N and longitudes 80.32°002' and 80.33°216'E. Matara town area is relatively flat or gently seaward sloping and elevation and topographic relief generally increases towards inland from the coastal line. Precambrian metamorphic hard rock covered by quaternary sedimentary deposits is dominant in the study area. The top quaternary sandy aquifer and the surface soils of the coastal margin of Matara town area are mostly permeable due to the sandy condition.

A network of 66 dug wells distributed over the Matara town area was selected for the present study. The dug wells were distributed within approx 9 km<sup>2</sup> area within the Matara city and dug wells were selected maintaining 3 major clusters such as; (1) very close to the coastal area (2) close to the Nilwala River and River mouth, (3) countryside.

Electrical conductivity (EC) of the Matara town area is change in the range of 316 to 1980  $\mu$  siemens/cm. The 21 % of the well water EC levels are exceeding the World Health Organization (WHO) standard for drinking water quality (WHO standard for drinking water quality below 1000  $\mu$  siemens/cm). In the study area EC and pH of the groundwater resources in the cluster two and three identified to be static and lies below WHO and Sri Lankan standards for drinking water, and as such it is a reliable source to meet the water demands of the population. But in the cluster one where dug wells are located in close to coast, EC values are relevantly high. The Regime of unconfined quaternary aquifer ground water level intimately related to atmospheric precipitation.

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424/D

#### **Preliminary study on inter-specific relationships of the genus *Pandanus* based on flavonoids and structural characters**

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Fifty six leaf flavonoid characters of fifteen *Pandanus* species were analyzed in order to infer inter-specific relationship of the genus. The existing classification for the genus is mainly based on leaf morphological characters as the flowers are not very common (Trimen, 1974 and Dassanayake & Fosberg 1981).

Leaf flavonoids, anatomical and morphological characters were observed and multivariate analysis was carried out using SYNTAX 2000 software package to study the relationships of the taxa. Twenty one percent of leaf flavonoid glycosides were found to be common in the selected 15 species of *Pandanus*. The phenograms were produced considering only the structural characters and also together with the flavonoid characters. The phenogram of the cluster analysis based on the analysis of 25 morphological, 01 anatomical and 56 flavonoid characters inferred relationships better than phenogram resulted from analysis of only the structural characters. According to the phenogram produced from the combination of characters, two varieties of *P. amaryllifolius* (vern Rampeh), which have differences in morphological features shared common cluster. This is in agreement with the consideration of these two as varieties of *P. amaryllifolius* by Dassanayake and Fosberg (1981). Further, two cultivated species of *Pandanus*, with variegated leaves, are seem to be closely related taxa according to the present phenogram.

The present study proved that the use of combination of chemical and structural characters would be more pragmatic in developing phenograms which indicate reliable inter-specific relationships in the taxonomic revisions of the genus *Pandanus*.

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**425/D**

### **Soil nutrient contents in the Ussangoda serpentine soil**

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Serpentine soils result from weathering of ultramafic rocks which contain high concentrations of Fe, Mg and Si. These soils are deficient in plant nutrients such as N, P, K and Ca. In addition, Mg, Fe and Ni occur in high concentrations. The ratio of Ca to Mg is <0.7 in serpentine soils, which is an important parameter to distinguish these from non-serpentine soils. Serpentine soils are sandy, shallow and well drained containing very low moisture. In addition they have a poor soil structure. All these factors present a hostile environment to plant life. This study is an attempt to assess the plant available elements at this site.

Ussangoda is one of the five serpentine sites in Sri Lanka, located on the southern coast of the island. The soil of this site is red in colour and has a plain area of 1 km<sup>2</sup> with a few interspersed islands of vegetation. The plain area consists of prostrate plants and the islands contain shrubs. The highest point is 34.5 m from sea level. Soil samples were collected according to the stratified random sampling technique representing three contours (10-20 m, 20-30 m and above 30 m) at a depth of 10 cm below the soil surface where most of the roots were present. Plant available micro-elements (DTPA method) and macro-elements (ammonium acetate method) were determined using the Atomic Absorption Spectrophotometer. The results were analyzed using one way ANOVA.

The available micro-elements, Fe and Mn were low at the higher elevation (69 µg/g and 27 µg/g respectively) than at the lower elevation (82 µg/g and 45 µg/g respectively). The other available micro-elements, Cu and Zn were detected at less than 2 µg/g. The macro-elements, Ca, Mg and K showed high variability. However the obtained result for Ca was significantly lower in the plains in comparison to the non serpentine areas (p=0.000). The Ca/Mg was less than 0.7 in the serpentine site and above 3 in non-serpentine. In addition, available Ni (non-essential element) was significantly higher (p=0.001) in the serpentine site in contrast to the non serpentine sites. Our preliminary results show that the Ussangoda serpentine site has the major characteristics of a typical serpentine soil (Ca/Mg ratio, presence of high Ni) and other features of its own.

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**426/D**

### **Hypoglycemic and anti-hyperglycemic activities of *Phyllanthus debilis* in mice**

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*Phyllanthus debilis* (family: Euphorbiaceae; in Sinhala: Ela-Pitawakka or Binnelli; in Tamil: Kilanelli) is one plant used in Ayurvedic medicine in Sri Lanka in the treatment of diabetic mellitus. However, hypoglycemic and anti-hyperglycemic activity of this plant has not been scientifically validated. The present study was carried out to examine the antidiabetic potential of *P. debilis*. Aqueous plant extract (APE) of *P. debilis* was prepared and normoglycaemic mice were gavaged either with 3 doses (497.5 mg/kg, 995 mg/kg & 1990 mg/kg body wt.) of APE, tolbutamide (33.5 mg/kg) or distilled water (control) and fasting and random blood glucose levels were determined. In addition, the toxicity of the APE was also examined using chronic administration (30 days). In normoglycaemic mice, high dose of APE significantly lowered the fasting blood glucose level in a dose-dependant manner. Further, APE markedly improved the oral glucose (1h: 13%, 3 h: 46% and 5 h: 51%) and sucrose ((3h: 32% and 5h: 25%) tolerance tests up to 5 hrs post-treatment. The improvement of the glucose tolerance test was dose-dependant. In addition, APE significantly inhibited glucose absorption from the small intestine (control vs. treatment: 24.21±0.96 vs. 47.55±1.25). The APE did not induce any overt toxic signs, hepatotoxicity (in terms of SGOT, SGPT and pathology) or renotoxicity (in terms of serum creatinine, urea and pathology). However, the total red blood cell counts and serum HDL levels were significantly increased. It can be concluded that APE of *P. debilis* is an orally active safe drug with antidiabetic potentials and with the ability to elevate HDL cholesterol levels and total RBC counts.

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427/D

#### **Determination of effects of water salinity on seed germination and growth performance of selected mangrove species**

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Although mangrove ecosystem is considered among the most productive ecosystems they are threatened world wide, because of human activities. Therefore replanting of mangroves is often used for there rehabilitation. Mass production of planting material and successful germination of seeds are essential to rehabilitate degraded mangrove areas.

Being salt tolerant plants the propagules of mangrove plants are able to establish themselves on the range of soil/ water salinities in the inter tidal zone. There performance therefore can be expected to be influenced by the salinity of water/ soil at the time of establishment. The present study was carried out to determine the optimum water salinity for germination and growth performance of seedlings of *Aegiceras coniculatum* (rare species) and *Avicennia marina* (common species)

Nine concentrations (0 ppt, 5 ppt, 10 ppt, 15 ppt, 20 ppt, 25 ppt, 30 ppt, 35 ppt and 40 ppt) of saline solution (NaCl) were used for saline treatments. Immersing in 0-5 ppt concentrations for 10-18 days was found to be the best practice for removal of epicarps of *A. coniculatum* propagules and immersing in 35- 40 ppt for four days of *A. marina* showed best germination and growth performances. Shoot height, number of leaves, leaf area and number of seedlings survived were taken as growth performance measurements.

Present study reveals that use of saline treatment, 35 - 40 ppt concentrations for four days and 0 -5 ppt for 10 -18 days is effective in increasing germination success of *A. marina* and *A. coniculatum*.

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428/D

### Fatty acid profiles of leafy vegetables consumed by Sri Lankans

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Epidemiological studies have shown that consumption of vegetables rich in antioxidants and polyunsaturated fatty acids could reduce risk of chronic diseases such as cardiovascular disorders, cancer, alzheimer and have beneficial effects on rheumatoid arthritis and inflammation. Although extensive studies have been carried out on the lipid profile of fish oil only few studies are reported on the oil from leafy vegetables and this study will be beneficial to the nutritionist in Sri Lanka and vegetarians.

Fatty acid profiles of six varieties *Ipomoea aquatica* (Sinh. Kankun), *Centella asiatica* (Sinh. Gotukola), *Alternanthera sessilis* (Sinh. Mukunuwenna), *Cardiospermum halicacabum* (Sinh. Penela), *Passiflora edulis* (Sinh. Passion fruit) and *Lasia spinosa* (Sinh. Kohila) obtained from the markets in Kiribathgoda were determined. The fresh leaves were immersed in isopropanol containing 0.01% BHT and extracted with CHCl<sub>3</sub>/H<sub>2</sub>O followed by CHCl<sub>3</sub>/CH<sub>3</sub>OH. The oil extracted was methylated using boron trifluoride methanol. Fatty acids composition of the oils and moisture contents were determined by gas chromatography and Dean and Stark method respectively. Determinations were carried out in quadruplets for each variety of leafy vegetables and for each analysis pooled out leaves from six bundles were taken. The results were statistically analysed by one way ANOVA.

*A. sessilis* (0.16 ± 0.08 g/100 g) and *L. spinosa* (0.14 ± 0.10 g/100 g) contained the highest amount of oil. Thirty methyl esters were identified from the 56 fatty acids detected using standards and previously analysed methylated cod liver oil. Poly unsaturated fatty acid (PUFA) content was high in all leafy vegetables analysed. Except in *I. aquatica* the content of monounsaturated fatty acid (MUFA) was lower than the saturated fatty acids (SFA). Palmitic acid (C16:0) {6.7% (*I. aquatica*) – 30.5% (*L. spinosa*)} was the major SFA. while oleic acid C18:1(n-9) {0.3% (*I. aquatica*) - 4.6% (*L. spinosa*)} was the major MUFA. Major PUFA found in the leaves were linoleic acid (C18:2 (n-6) {32.6% (*L. spinosa*) – 5.6% (*I. aquatica*)}, the precursor for arachidonic acid (AA) and α - linolenic acid [C18:3(n-3){53.3% (*C. halicacubum*) – 17.1% (*I. aquatica*) which is the precursors for docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). DHA and EPA, the health beneficial PUFA and AA, the precursor for prostaglandin were not detected in the leaves analysed.

The results of the present study revealed that the oil of the non conventional leafy vegetable *C. helicacubum* is the best sources of oil that could contribute to the beneficial health effects for it contained the highest % of PUFA, lowest SFA and highest amount of α - linolenic acid, the precursor for EPA and DHA.

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429/D

### **Reconstruction of stature from fragmented skeletal remains of a prehistoric population in Bellan-bandi Palassa in Sabaragamuwa Province**

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The stature is influenced by genetic and environmental factors such as climate, food and nutrition. Many genes are involved in the control of body size and form. In a single individual, height increases until adulthood is reached, and decreases as senility approaches.

Sri Lanka has evidence of pre-historic settlements possibly 500,000 BP or earlier. The first anatomically modern man termed 'Balangoda Man' lived during the pre-historic period. We have reconstructed the stature by studying the long bone fragments excavated from Bellan-bandi Palassa pre-historic site. Since complete long bones were not available in skeletal remains we were unable to use the regression formulae used to calculate stature from long bones described by Trotter & Gleser (1952). We have adopted the method described by Krogman (1962) to estimate the stature from fragmented long bones. First the total length of the bone was estimated and secondly this length was used in statural formulae. Trotter & Gleser (1952) formulae were applied for the estimation of stature from calculated lengths of long bones.

The reconstructed mean stature of the prehistoric man in Bellan-bandi Palassa is 140.05 cm ( $\pm$  4.21 SD). This value is less than the mean stature of present population (164.19 cm) living in Sri Lanka. This result is consistent with gradual increase of body size from pre-historic to the present. The reconstructed mean height being less than present day population also cast doubts on the report of Kennedy (1993) that this group found in Bellan-bandi Palassa was larger in size than present day Sri Lankans.

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430/D

### **Effect of mismanagement of minor-perennial tank, Uduwela reservoir, Narammala, towards fish production**

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Sri Lanka has the highest density of freshwater resources compared to its land area in the world i.e. over 250 000 ha which means that 1/25 of it is covered with water. Majority of these resources consist of seasonal and perennial reservoirs which are man-made.

A fish stocking programme of these reservoirs has been effected from 1951. Carp is considered as one of the most suitable species for these water bodies. It is mandatory to stock carp fingerlings at 1-2 fish/m<sup>2</sup> rate annually and in order to achieve higher survival rate they should be stocked in a rational way. Present study was carried out to determine the factors that had been affecting the sustainable management of a minor perennial tank, Udawela reservoir Narammala. Past research revealed that total fish carp fingerlings had been stocked into this reservoir is only once during the past five years and total had been only 2000. This shows that only 0.5% of the total requirement has been stocked. As a result only 24.4kg monthly production was recorded from January to May 2007. 9% of *Channa striatus* and 5% of *Clarias brachisoma* were in the catch. Since all these fish are carnivorous, the need to stock healthy carp fingerlings at higher stocking densities is hereby stressed. 74% *Oreochromis mossabicus* is the major species that was caught from the reservoir. Only 12% of the introduced carp fish by weight were in the catch.

Although the carp harvest was low due to the fact that the stocking was low, results show that this reservoir can be efficiently used for stocking of carp. A theoretical estimate of 7 500 kg annually could be easily harvested through proper management. Management can be achieved, the establishment of a co-management system with a carp based fishery and the development of a reservoir cove for the continuous stocking of carp fingerlings would be essential for sustainable development of these minor-perennial reservoirs.

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#### 431/D

##### **Influence of seed abundance on two ground-dwelling murids in the Kanneliya rainforest**

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The food limitation hypothesis is said to govern the abundance of small mammals in tropical rainforests. This investigation therefore attempted to ascertain the influence of seed availability on the two predominant ground-dwelling rodents *Mus mayori* (Sri Lanka Spiny rat) and *Rattus rattus kandianus* (Common Sri Lanka House rat) in the Kanneliya rainforest. The study was conducted from October 2006 to March 2007. Six plots of 40 x 90 m located at least 500 m apart were randomly selected and population sizes of the two murids were estimated using a four-day live trapping session in each plot. Seed searches were simultaneously carried out within the plots. After the initial trapping session was completed food enrichment trials were carried out in the six study plots for two weeks. The population sizes of the murids were ascertained for a second time after food enrichment using the same live trapping protocol. Seed predation rate was also estimated during the food enrichment trials.

A total of 65 individuals were captured in the six study plots which included 35 individuals of *M. mayori* (53.8 %) and 29 individuals of *R. r. kandianus* (44.6 %). Only one individual of *Suncus zeylanicus* was captured during the study. The mean abundance of rodents prior to food enrichment was 10.67 ( $\pm$  2.8) with that of *M. mayori* being 5.83 ( $\pm$  1.3) and *R. r. kandianus* being 4.83 ( $\pm$  1.6). Seed addition in the six plots resulted in a significant increase in rodents with total mean abundance attaining 18.33 ( $\pm$  2.2) (Paired T-Test for total rodents,  $T = 2.77$ ,  $P < 0.05$ ). The mean abundance of the individual species after food addition was 10.83 ( $\pm$  1.8) for *M. mayori* and 7.5 ( $\pm$  0.8) for *R. r. kandianus*. Seed predation rate in Kanneliya was 5.42 g ( $\pm$  0.95) per day. Seed searches revealed the presence of 16 seed/fruit types among the leaf litter of the forest. Although a positive effect was observed between natural seed availability and rodent abundance this trend was not significant. The results of this investigation thus

indicate that food availability, particularly during the non-fruiting season, may at least in part regulate rodent populations in tropical rainforests.

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432/D

**Parasitic associations of endemic *Mus mayori* (Sri Lankan spiny rat), in the Kanneliya rainforest, Sri Lanka**

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Parasites affect ecological interactions among different host species and may cause serious losses in already small populations of endangered species. Therefore, investigating the disease burden on wildlife is an important aspect of wildlife management and conservation.

A preliminary parasitic survey of a predominant ground-dwelling endemic rodent, *Mus mayori* (Sri Lankan Spiny rat), in the Kanneliya rainforest in Sri Lanka, was carried out during October 2006 to March 2007. The survey was conducted on animals that were trapped in six study plots within the forest. Ecto-parasites were searched on the body, paws and ears of each captured individual and by combing their fur. Faecal matter from trap bags and those discharged during handling were collected to carry out investigations on intestinal parasites.

Of the captured animals 76 % ( N = 75 ) were infected with ecto parasites, of which 24 % carried high parasite loads. Among the ecto parasites encountered were two species of mites and one species each, of lice, ticks and pseudoscorpions. The percentage occurrence (% individuals with a particular ecto parasite) for the two most frequently found ecto parasites were, 76 % for mites and 5 % for lice. Some parasites collected from *M. mayori* were identified as, mites of the genus *Echinolaelaps*, tick of genus *Ornithodoros*, and lice of species *Polyplax serrata*. These ecto parasites are first time records for this endemic host in Sri Lanka.

Examination of faecal matter from 12 animals revealed the presence of four helminth egg types (strongyles type, strongyloides type, ascaris type and cestode type) and some mite eggs. In addition, a nematode larvae was also recorded in the faecal matter of one individual.

This study provided information on parasitic associations of an endemic rainforest rodent in Sri Lanka. These findings could also aid in ascertaining the role of parasitic diseases in regulating small mammal populations in tropical rainforest ecosystems.

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433/D

**Present status of shark fishery as indicated by the commercial catch unloaded at Pitipana  
Negombo, South West coast of Sri Lanka**

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The history of the shark fishery is not well documented. Although the shark fishery in Sri Lanka has existed for many years, sharks are among the least known component of the Sri Lankan large pelagic catches. Population parameters of sharks too, remain a much-neglected subject in Sri Lanka. Although the need for studies on sharks is great, the knowledge on sharks landed in Sri Lanka is still meager. The purpose of the present study was to study the present states of the fishery.

The shark catches in the commercial fisheries were monitored twice a month at the main fish- landing site at Negombo, during the period May 2006 to April 2007. The collection of data and other relevant information were carried out from 4.45 am to 7.30 am. The study revealed the occurrence of 16 species of pelagic and demersal sharks belonging to 2 orders, namely Lamniformes and Carcharhiniformes. The most diverse order among them was Carcharhiniformes. It comprised 2 families, 5 genera and 12 species. The above two families, namely, Carcharhinidae and Sphyrnidae reported 7 species of Carcharhinus namely, *C. falciformis*, *C. brevipinna*, *C. limbatus*, *C. melanopterus*, *C. longimanus*, *C. albimarginatus*, *C. sorrah* and 2 Sphyrna species, *S. lewini* and *S.zygaena*. The other genus comprised one genus each, *Prionace glauca*, *Triaenodon obesus* and *Galeocerdo cuvier*.

The second most diverse order in the catches was Lamniformes with two families, two genera and four species. The families were Lamnidae and Alopiidae. There were two Alopias species; *A. pelagicus* and *A. vulpinus* and two *Isurus* species; *I. oxyrinchus* and *I. paucus*.

Over 64.05 % of the sharks landed belonged to the order Carcharhinidae with *Carcharhinus falciformis* (55.03%) being the most dominant species and it has dominated the catch almost through out the year.

The values for  $L_{\infty}$  and K estimated for the stock of *Carcharhinus falciformis* were 199.93cm and 0.250/yr respectively. The instantaneous total mortality coefficient (Z) was 0.26; the natural mortality coefficient (M) was 0.02 and the fishing mortality coefficient (F) was 0.24.

The values for  $L_{\infty}$  and K estimated for the stock of *Alopias vulpinus* were 208.77cm and 0.400/yr respectively. The Z was 1.49; the M was 0.02 and the F was 1.47.

The estimated exploitation rate (E) for *C. falciformis* and *A. vulpinus* were 0.92 and 0.99 respectively. As the present level of exploitation seems to be high, it is suggested that management measures are needed to sustain the stock.

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434/D

### Identification and biology of the palm weevil, *Rhabdoscelus maculatus* in foliage palm nurseries

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The palm weevil, *Rhabdoscelus maculatus* was recently found to be an important pest of ornamental palms in foliage nurseries in Sri Lanka. Although the incidence of this weevil is restricted to ornamental palm nurseries, there is a very realistic risk of it becoming a pest of important cultivations such as coconut and sugarcane. Identification and the biology of this weevil was therefore, studied with the view of finding a suitable, environmental friendly control method.

The adult is a small, reddish-brown weevil with two black markings on the elytra and the thorax. It is about 12-16mm long and 4-6mm wide. Adults are usually found hiding under leaf sheaths of the palm during the day. They are nocturnal in habit and feed on the plant sap. Eggs are laid inside cavities made in the leaf sheath by mature females. These hatch in about 5-6 days. The larva is a creamy white, legless grub with rounded, highly sclerotized, reddish brown head capsule. After emerging it burrows down the leaf sheath and then tunnels into the stem. The diameter of the tunnel varies with the larval stage (5-7mm). Tightly packed, fine pieces of fiber are always observed in the tunnel behind the larvae. After about 20-25 days the larvae burrow into the bud of the palm feeding on the young tissue and the buds of attacked plants can be easily removed. Infestation of the palm is revealed by a jelly like substance oozing from the holes in the leaf sheaths. Larva takes about 8-10 weeks to complete its development. Pupation takes place inside a cocoon made with tightly bound, fibrous material. The pupal period is 19-21 days. The emerging adult chews and makes a small exit hole in the cocoon as an escape route. The total life cycle takes 9-10 weeks to complete with four generations per year.

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435/D

### Range extension of *Xyleborus fornicatus* Eichh. (Coleoptera: Scolytidae), the shot-hole borer of tea in Sri Lanka: An emerging threat to tea plantations in the highlands

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The Shot-hole borer, *Xyleborus fornicatus* is one of the serious pests of tea causing serious damages in elevations between 200 to 1400m amsl. The damage is twofold viz. the primary damage occurs as a result of constructing galleries in the stems by the beetle, subsequently leading to yield loss. The secondary, but most damaging is the setting in of wood rot through the exposed galleries, which if unchecked, results in long term debilitation of the tea bush. There is a serious concern among growers that the pest is expanding its' range to areas previously free from infestation especially in the upper elevations.

A comparison of the historical records on the highest elevations where the pest was found during the period from 1950 to 2005 indicates that the pest had expanded its' active range by about 200m over a period of 50 years; a four meter expansion per year! A notable observation made was that high infestation levels in several plantations in high elevations (> 1300m), which have not been reported previously. Assessments were made on DT 1 and TRI 2025, two cultivars grown for its' ability to produce quality tea and for the yield potential respectively, in these areas. The results showed that high infestations viz. percent infested stems (Number of stems with galleries/Total number of stems sampled x 100), ranging from 60 – 100% and average number of galleries/stem (Total number of galleries in the sample/Total number of stems sampled), ranging from 2.7 – 6.6. It was also observed that the extents under these two cultivars in those selected plantations (Kotagala area of the Nuwara Eliya District) ranged from 48 – 78% of the total, which is also contributing to the problem. In the light of these observations it is clear that the plantations in the high elevations would suffer more damage in the future as a result of the range extension of this pest, associated with the impending change in the climate.

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**436/D**

**Effect of aqueous leaf extract from clove, *Eugenia caryophyllata*, on second-stage juveniles of *Meloidogyne javanica***

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The effect of aqueous leaf extract from clove *Eugenia caryophyllata* Thunberg (Myrtaceae) on second-stage juveniles (J2s) of *Meloidogyne javanica* was tested *in vitro* at the standard concentration (S) ((1:2 (w/v)) and four dilutions, i.e., 20%, 40%, 60% and 80% of S. Standard distilled water (SDW) was used as untreated controls. The J2s in 1 ml SDW were exposed to 1 ml of test extract for 48 h at the ambient temperature (30°C±2).

The extract significantly reduced the survival of J2s at all the concentrations tested compared to untreated controls. The mortalities varied in a dose-dependent manner. The highest mortality (100%) was observed at the S whereas the lowest mortality (18%) was detected at the 20% of S. In general, nematode mortality increased with the increasing concentration. The LC<sub>50</sub> value for J2 mortality was detected at 33% of S. In addition to causing mortality, the clove leaf extract induced nemato-static effect in J2s of *M. javanica* at 20%, 40% and 60% of S. The highest nemato-static effect was found at 20% of S. Our findings clearly indicated that the clove leaf extract affected on survival and mobility of J2s of *M. javanica* confirming that it has a high nematicidal potential.

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437/D

**Modeling habitat suitability for the Sri Lanka Grey Hornbill (*Ocyceros gingalensis*) and Malabar Pied Hornbill (*Anthracoceros cornatus*); a GIS approach**

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A predictive spatial model was developed in order to identify specific habitat characteristics and distribution pattern of Sri Lanka Grey Hornbill (*Ocyceros gingalensis*) and Malabar Pied Hornbill (*Anthracoceros cornatus*) at the Giritale Nature Reserve in the North-Central province of Sri Lanka. Hornbills were surveyed between March 2006 and February 2007. Randomly selected line transects were traversed slowly on foot between 06:00 – 11:00 hrs in each month. Coordinates of points were recorded in 150 m intervals using a global positioning system (GPS). Twenty five meter buffer was created for every point. The points around which hornbills were observed was recorded as present sites and others were recorded as absent sites. Height, distance to the water bodies and habitat complexity were taken as potential predictor variables. Triangulated Irregular Network (TIN) was created by using contour layers of 1:50,000 topographic maps. TIN was converted in to 25 m resolution Digital Elevation Model (DEM). Initial DEM was converted in to polygon shape file. Habitat complexity was used as an index of vegetation structure that incorporated tree canopy, shrub canopy and ground herbage coverage. Sample points were selected for each land use category and percentage of canopy cover, opening above 15 m, shrub canopy below 15 m and ground herbage coverage was recorded. Average values for each category was applied in to different land use classes of the area. Present and absent areas that were input into GIS and landscape values were extracted using ArcGIS (ESRI, 2001). Stepwise regression was performed to develop the distribution model of the hornbill according to habitat variables. The results indicated a significant correlation between the presence of hornbills and distance to water bodies, height and percentage of canopy cover while stepwise regression removed the percentage of opening above 15 m, shrub canopy below 15 m and ground herbage coverage from the model. The observed positive association between increasing canopy cover and presence of hornbills also indicated that they prefer a dense vertical vegetation structure. However, a validity test should be conducted to confirm the findings of this study. Acknowledgement: Financial assistance by University of Sri Jayewardenepura(B/3870-1)

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438/D

**Fat contents and fatty-acid profiles of five species of tuna**

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The total fat content and fatty acid profiles of the flesh of five tuna species skipjack (*Katsuwonus pelamis*), Yellow fin tuna (*Thunnus albacare*), Bullet tuna (*Auxis rochei*), Frigate tuna (*Auxis thazard*) and kawakawa (*Euthynnus affinis*) were obtained from Pitipana, Negombo landing site were determined. Samples of skin, red muscle, white muscle, head muscle and belly flap were taken to determine the total fat and the moisture content in each species. Total fat contents were determined by Majonnier method. For Gas Chromatography (GC) analysis of fatty acids, oils were extracted from the Bligh and Dyer method and the Fatty Acid Methyl Esters (FAME) were prepared by sodium methoxide method. FAMES, were then identified by injecting into the GC (Agilent 4890 D) and FAMES

were identified from previously prepared standard (cod liver oil) and from a reference standard (GLC 411). Concentration of each F0AME was calculated as a percentage of total FAMES. Among these five tuna species the total fat contents in the flesh (red flesh and white flesh) were lower than 2%. Therefore these can be considered as lean fat fishes (lean <2%, low 2-4%, medium 4-8% high >8%). The distribution of fat in the different tissues was as follows; skin ( $3.41 \pm 0.30$  -  $9.88 \pm 0.99$  %), red flesh ( $0.56 \pm 0.11$  -  $1.23 \pm 0.15$  %), white flesh ( $0.54 \pm 0.05$  -  $0.80 \pm 0.12$  %), head ( $1.05 \pm 0.44$  -  $1.35 \pm 0.80$ %), and belly flap ( $0.66 \pm 0.06$  -  $1.56 \pm 0.22$ %). The highest storage of fat was reported in the skin ( $3.41 \pm 0.30$ % -  $9.88 \pm 0.99$ %), while the lowest storage was reported in white flesh ( $0.54 \pm 0.05$  % -  $0.80 \pm 0.12$ %) in all five tuna species considered here. There was a negative correlation between the total fat content and moisture content (Pearson's correlation -0.853,  $p < 0.05$ ). The fatty acid composition of Saturated Fatty Acids (SFA), Mono unsaturated Fatty Acids (MUFA), and Poly Unsaturated Fatty Acids (PUFA) were as follows; Yellow fin tuna: 20, 22, 58; skip jack: 17, 34, 50; frigate tuna: 18, 25, 56; bullet tuna: 20, 20, 58; Kawakawa: 26, 23, 41. The proportion of Eicosapentanoic acid (EPA, 20 5n-3) and Docosapentanoic acid (DHA, 22 6n-3) in the fat of yellow fin tuna (13.57%, 12.51%), bullet tuna (13.51%, 7.23%) and skip jack (4.34%, 12.63%) were high compared to other two species namely; frigate tuna (6.96%, 4.86%) and kawakawa (8.65%, 5.89%). The proportion of SFA was high in kawakawa, while others recorded less than 20% of SFA. The proportions of USFA were; Yellow fin tuna 80%, skipjack 73%, frigate tuna 82%, bullet tuna 78%, and kawakawa 63%.

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439/D

### Some mineral elements in five species of tuna

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Fish and shellfish inevitably supply essential macro and trace elements to the human diet. Five predominant tuna species namely; skipjack (*Katsuwonus pelamis*), Yellow fin tuna (*Thunnus albacare*), Bullet tuna (*Auxis rochei*), Frigate tuna (*Auxis thazard*) and kawakawa (*Euthynnus affinis*) were selected to determine some mineral elements (Na, K, Ca, Mg, Zn, Cu, Fe, Cd, Ni and Pb). Samples of the five tuna species were collected from Pitipana, Negombo landing site (July 2006 to December 2006). The edible portions of muscle were separated from the washed, cleaned, eviscerated and filleted fish samples and were dried in a muffle furnace to obtain ash. The mineral content and heavy metal content of each ash sample was assayed after dissolving in 5N HCl and were analyzed by an Atomic Absorption Spectrophotometer (GBS 932 plus). The concentrations of the Na ( $1155.4 \pm 403.5$  -  $1407.1 \pm 231.2$   $\mu\text{g/g}$ ), K ( $3024.3 \pm 389.3$  -  $4357.7 \pm 708.6$   $\mu\text{g/g}$ ), Ca ( $676.7 \pm 49.9$  -  $735.8 \pm 37.5$   $\mu\text{g/g}$ ), Mg ( $470.4 \pm 91.2$  -  $684.4 \pm 21.0$   $\mu\text{g/g}$ ), Fe ( $16.04 \pm 2.81$  -  $34.65 \pm 1.11$   $\mu\text{g/g}$ ), and Zn ( $0.45 \pm 0.29$  -  $1.98 \pm 1.68$   $\mu\text{g/g}$ ) in each species were not significantly different ( $p > 0.05$ ). In this study K concentration was consistently higher than the Na concentration in all the species and the ratio of Na:K was 1:3 in all the species except skip jack in which it was 1:4. The concentration of Fe and Ca ranged from  $16.04 \pm 2.81$  -  $34.65 \pm 1.11$   $\mu\text{g/g}$  and  $676.7 \pm 49.9$  -  $738.3 \pm 20.4$   $\mu\text{g/g}$  respectively. The average Mg concentration in edible portion of these tunas was ranged from  $470.4 \pm 91.2$  -  $684.4 \pm 21.0$   $\mu\text{g/g}$ . In this study Zn concentration was ranged from  $0.45 \pm 0.29$   $\mu\text{g/g}$  to  $1.98 \pm 1.68$   $\mu\text{g/g}$ . The highest Zn concentration was recorded in yellow fin tuna and skipjack ( $1.98 \pm 1.68$  and  $1.14 \pm 0.74$   $\mu\text{g/g}$  respectively). The Cu concentration among these five tuna species was ranged from  $1.33 \pm 0.04$   $\mu\text{g/g}$  to  $2.50 \pm 1.19$   $\mu\text{g/g}$ . Cd was detected only in one sample of yellow fin tuna ( $0.05$   $\mu\text{g/g}$ ), which did not exceed its permissible level of  $0.25$   $\mu\text{g/g}$ . Although Pb was detected in every

sample of both yellow fin tuna and skipjack ( $1.22 \pm 0.77 \mu\text{g/g}$  and  $0.36 \pm 0.25 \mu\text{g/g}$  respectively) the levels were not exceeding the permissible level ( $2.5\mu\text{g/g}$ ). There was a significant difference in Pb concentration between yellow fin tuna and skipjack. Ni was detected only in one sample of skipjack ( $0.025\mu\text{g/g}$ ).

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**440/D**

### **Species richness and species diversity of small mammals at the Giritala Nature Reserve of North Central Sri Lanka**

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Small mammal species richness and diversity at the Giritala Nature Reserve of north central Sri Lanka was studied from June 2006 to August 2007. Sherman traps and Pitfall traps (Mazerolle et al., 2001) were used to capture the small mammals. The study was conducted at four habitat types as grasslands, shrubs, forests and human habitat. Traps were laid on three consecutive nights per month in each habitat type (King et al., 1996). Sixty four small mammals belonging to families Soricidae, Muridae and Scuridae and orders Insectivora and Rodentia were recorded in 1560 trap nights at four different habitat types. Species recorded included, *Suncus murinus murinus* (Common Indian Musk Shrew), *Mus cervicolor fulvidiventris* (Ceylon Field Mouse), *Mus musculus castaneus* (Indian Field Mouse), *Mus fernandoni* (Ceylon Spiny Mouse), *Rattus rattus rattus* (Common House Rat), *Rattus rattus rufescens* (Indian House Rat), *Rattus blanfordi* (White Tailed Rat) and *Funambulus palmarum* (Indian Palm Squirrel). Human habitats had the highest Shannon diversity ( $H'$ ) index of 1.59 while sShrub-lands had the lowest diversity index of 0.57. In contrast grasslands had a high abundance of 0.07 compared to the abundance of 0.04 for the human habitats. Evenness was low in grasslands (0.55) and high in shrubs (0.97). Number of small mammals captured was significantly different in the four habitat types ( $\chi^2 = 19.93$ ,  $DF=3$ ) with grasslands having the highest capture rate of 47% and shrub-land having a lowest rate of 8%. Seven species were observed in more than one habitat. Present study which is the first to reveal the species richness, diversity and abundance of terrestrial small mammals at the Giritala Nature Reserve, indicated that the grasslands of nature reserve comprise of a rich species diversity of small mammals and hence warrants protection.

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**441/D**

### **Some aspects of feeding of catfish- *Arius bilineatus* in Bolgoda Lake System**

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Some aspects of feeding of cat fish *Arius bilineatus* (Family Ariidae), inhabiting the Bolgoda Lake system was studied with the objective of acquiring knowledge on the types of food they consume and

the variation in food composition with their size and the habitat they live. Such information is vital in aquaculture of this species, which has a good potential as an export commodity. Samples for the study were collected from commercial fishermen operating in three selected sites (namely, a Jakotu trap, a site within the close proximity to two tourist hotels, a site close to the estuarine mouth where a fish landing site and a number of poultries are located), throughout six consecutive months with a sample collection frequency of twice a month. A total of 66 specimens were used for the study and the preserved gut contents of these specimens were analyzed using a stereo microscope following a numerical method.

*Arius bilineatus* in the study sites have fed on a variety of food items which included fish (e.g. *Ambasis sp*, *Mugil sp*) (between 21.5% -41.2% in composition), crustaceans [ e.g. *Metapenaeus ensis* (Koralissa), *Metapenaeus dobsonii* (Malissa)] (between 5% -35.5% in composition), Molluscs (between 3.5% -17.5% in composition), other invertebrates (e.g. aquatic insects, bristle worm, nematode worm, Oligochaeta, Polychaeta, *Tubifex*, *Planaria*, *Hydropsyche*, *Nympula*) (between 4% -18.2% in composition). In addition to these items, only those who were caught from the site near the estuarine mouth had a high percentage (66.5%) of fish/meat offal in their stomach contents. These observations show that this species is carnivorous. A high percentage of meat/fish offal in the stomachs of fish caught from the site near the estuarine mouth where fish and meat offal are thrown into the surrounding waters from fish landing site and poultries reveal the fact that they are able to thrive on live as well as non-living food organisms thus can be easily fed with a variety of food items when cultured.

There was no marked difference in the percentage composition of the above food items in stomach contents of fish caught from three sites and different size ranges of this fish species also have consumed the same variety of food. These observations suggest that this species is an opportunistic feeder which further qualifies it as a potential candidate for aquaculture.

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**442/D**

**Study on Erythrina Gall wasp (*Quadrastichus erythrinae* Kim); a newly recorded pest species on Eramudu (*Erythrina subumbrans*.Hassak.) plants**

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*Erythrina subumbrans*, well known as Eramudu is a common tree grow throughout the country for long period without visible pest damages. In 2005 young shoots, leaves and leaf petioles of Eramudu plants grown in Matara district were severely deformed due to the formation of galls. Similar observations were made for plants grown in many parts of the country.

Present study reveals that these galls are formed due to the attack of tiny wasp belong to the family Eulophidae of order Hymenoptera. Life cycle of the pest completed within 20 days. Adult females lay eggs on young shoots and entire larval and pupal stages are completed within the galls. Galls formed in leaves were smaller than the galls form on leaf petioles ( $p < .05$ ). Young plants were destroyed due to pest damage, but mature plants are producing small buds with 100% infestations. None of the infected plants produced any flowers, which have very high cultural value to the country. Natural enemies were not recorded during the study period. In addition other leguminous plants belong to family Fabaceae were not affected by the pest

Taxonomic studies revealed that this pest was described in 2004 as a new species using the specimens from Singapore, Mauritius and Reunion. Since then it has been reported from Taiwan, Hong Kong and India affecting *E.variagata* L. plants. The pest was identified as highly invasive species affecting Erythrina plants in many parts of the world.

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443/D

**Effect of NeemAzal-TS<sup>®</sup> and spinosad on the viability of infective juveniles of two entomopathogenic nematode strains**

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In recent years, entomopathogenic nematodes (EPNs) of the families Steinernematidae and Heterorhabditidae, and the two bio-pesticides, neem and spinosad are acquiring great attention as promising biological control agents of economically important insect pests. Hence, there will be a high potential to incorporate them in Integrated Pest Management programs. However, it is a prerequisite to determine the compatibility of EPNs with these pesticides. In the present study the potential direct contact effects of NeemAzal-TS<sup>®</sup> (1% Azadirachtin A) and spinosad (12% w/v SC), were evaluated on the viability of infective juveniles (IJs) of two entomopathogenic nematode (EPN) strains, *Steinernema siamkayai* n. sp. and *Steinernema carpocapsae* Weiser All strain (both Rhabditida: Steinernematidae) at three dose rates, i.e., 3, 5 and 7 ml / liter water (ml/lw), and 5, 10 and 20 ml / 20 lw, respectively, in multi-well plates. The viability of IJs was assessed at 6, 12, 24, 48 and 72 h after exposure to each bio-pesticide. Distilled water was used as untreated controls. Irrespective of the exposure times and dose rates tested both bio-pesticides had no effects on the viability of IJs of *S. carpocapsae* and *S. siamkayai* indicating that these two EPN strains are compatible with the use of NeemAzal-TS<sup>®</sup> and spinosad in IPM systems.

Key words: Entomopathogenic nematodes, NeemAzal-TS<sup>®</sup>, spinosad, viability.

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444/D

### Gastroprotective activity of Sri Lankan black tea (*Camellia sinensis* L.) in rats

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This study examined the gastroprotective potential of black tea brew (BTB) of *Camellia sinensis* (Theaceae) using Sri Lankan high grown Dust grade No: 1 tea in rat alcohol induced gastric lesion model. Four oral doses of BTB equivalent to 1.5, 3, 9, or 24 cups were used in the evaluation of the gastroprotective activity. The results showed a strong dose dependent and significant ( $P < 0.05$ ) gastroprotective activity (in terms of number, length and area of haemorrhagic lesions). The high dose of BTB (equivalent to 9 cups and the only dose tested) also offered gastroprotection in rat indomethacin and serotonin induced gastric lesions models. Intraperitoneal treatment of BTB and oral treatment of BTB following decaffeination suppressed its gastroprotective potential. However, indomethacin pretreatment did not reduce the gastroprotective potential of BTB in the ethanol induced gastric lesion model. BTB also increased the gastric mucus content (by alcian blue test), thickness of the gastric mucus layer (by histopathology), pH of the gastric contents, and possibly gastric mucosal blood flow and reduced the gastric output of the stomach. BTB also had antihistamine (by wheal test) and antioxidant activity (by DPPH method) and impaired the gastric transit (by charcoal plug test). It is concluded that BTB of *C. sinensis* possesses strong, oral gastroprotective action, which is mediated via multiple mechanisms.

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445/D

### Distinguishing larval instars of leafminer, *Liriomyza sativae* (Diptera: Agromyzidae), infesting tomato

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Identifying and distinguishing the larval instars is an important prerequisite for effective management. The number of larval instars of *Liriomyza sativae* was determined by using the frequency distribution pattern and by regressed the logarithms of the length of mouth hook and the cephalopharyngeal skeleton against instar numbers. Both measurements showed clear separation between larval instars. Three larval instars were found in *L. sativae*. Morphologically body size and colouration showed clear distinct between the larval instars. First instar larvae were nearly colourless, second instar larvae were pale yellow and third instar larvae were range from yellow to yellowish orange. Significant correlation was observed when length of cephalopharyngeal skeleton regressed against length of mouth hook ( $r=0.8887$ ). Body length of first, second and third instar larvae was  $0.357\pm 0.12\text{mm}$ ,  $0.909\pm 0.19\text{mm}$  and  $1.747\pm 0.241\text{mm}$  respectively. Mean length of cephalopharyngeal skeleton for first, second and third instar larvae was  $0.075\pm 0.013\text{mm}$ ,  $0.145\pm 0.013\text{mm}$ ,  $0.219\pm 0.012\text{mm}$  respectively. Mean length of mouth hook of first, second and third instar larvae was  $0.0111\pm 0.004\text{mm}$ ,  $0.0374\pm 0.006\text{mm}$ ,  $0.0628\pm 0.004\text{mm}$  respectively. The growth ratio of cephalopharyngeal skeleton between first and second larval instars was higher (1.93) than between second and third instar larvae (1.51) likewise the growth ratio of mouth hook between first and second larval instars was higher (3.36) than between second and third instar larvae (1.6).

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446/D

### **A preliminary inventory of worker ants (Family: Formicidae) in Sinharaja forest**

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Ants (Order: Hymenoptera; Family: Formicidae) belonging to twelve subfamilies have been recorded from Sri Lanka. Sinharaja forest is recognized as a hot spot of biodiversity but little is known about the ant community of this forest. A survey on worker ants in Sinharaja forest was carried out by sampling them for three days in February, April and June in 2005. Honey baiting, litter sifting, soil sifting and pitfall trapping were carried out along a 100 m transect marked in ten sites of this forest. Honey baits (25) were kept at 4 m intervals and collected after an hour into bottles filled with 50% ethanol. Some ant species observed on the honey baits were identified and recorded with their numbers in the field while preserving the unknown species in 85% ethanol. Litter sieving (10) and soil sieving (20) were carried out at 10 m and 5 m intervals, respectively. Honey baited pitfall traps (10) were fixed in the evening at each of three sites to collect night foragers. Dry weather in February and June and, rain in April prevailed during the field sampling. Air temperature (21°C – 27.5°C), soil temperature (21°C – 25°C), mean litter depth (2.1 cm – 6.3 cm) and soil humidity (11.9% - 47.8%) of each site were also recorded.

Significant differences were not observed (chi square test;  $p > 0.05$ ) among the Species Richness values (February: 31, April: 35, June: 33) for the three occasions. Forty six species and morphospecies of ants were identified collectively from the Sinharaja forest. Worker ants belonging to eight subfamilies, Aenictinae, Amblyoponinae, Aneuretinae, Cerapachyinae, Dolichoderinae, Formicinae, Myrmicinae and Ponerinae were observed. *Aphaenogaster* sp. 1 (32.6%) was dominant whereas *Technomyrmex bicolor* Emery (18%), *Pheidole* sp. (8.7%), *Tetramorium* sp. 2 (6.3%), *Aphaenogaster* sp. 2 (5%), *Pheidologeton* sp. 1 (3.8%), *Myrmecaria* sp. (3.5%), *Lophomyrmex* sp. (3.2%), *Pheidologeton* sp. 2 (2.2%), *Aneuretus simoni* Emery (1.8%) *Tapinoma* sp. (1.5%), *T. albipes* (1.6%), *Paratrechina* sp.1 (1.6%) *Tetramorium bicarinatum* (1.6%) and *Hypoponera* sp. 1 (1.5%) were observed in lower proportions. Each of the other morphospecies contributed less than 1% to the ant community in this forest and the rare ants *Amblyopone* sp., *Harpegnathos* sp. and *Vollenhovea* sp. were also observed. The average Frequency of Occurrence of *Aneuretus simoni* Emery (Sri Lankan Relict ant) in this forest was 50%, 80% and 40% in February, April and June, respectively.

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447/D

### **Distribution and incidence of root-knot nematodes, *Meloidogyne* species associated with selected leafy-vegetable species in Matara District**

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Distribution and prevalence of root-knot nematodes, *Meloidogyne* spp., associated with four leafy vegetable species, i.e., “Gotukola” (*Centella asiatica*), “Kangkung” (*Ipomea aquatica*), “Mugunuwenna” (*Alternanthera sessilis*) and “Thampala” (*Amaranthus oleraceus*) grown at 15 localities in Matara district were determined by means of a survey during June 2005 - April 2007. At each locality, fifty individual root systems from fifty individual plants were inspected for the presence of root-galls based on the visual symptoms or at random. Out of these root systems, at least ten infested root systems were assessed for the percentage root system galled. *Meloidogyne* species were identified up to the species level using perineal pattern morphology of mature females.

*Meloidogyne* incidence was detected only on three leafy-vegetable species, i.e., “Kangkung”, “Mugunuwenna” and “Thampala”. No *Meloidogyne* infestations were found associated with “Gotukola” at any of the field surveyed. In contrast, about 60% of “Mugunuwenna” and “Thampala” and, 40% of “Kangkung” fields sampled showed *Meloidogyne* infestations. Three *Meloidogyne* species were found, i.e., *M. arenaria*, *M. incognita* and *M. javanica*. *Meloidogyne incognita* was identified as the most distributed and prevalent species associated with these leafy-vegetable species tested at all the locations. Often, these nematode species occurred in mixed populations in root systems. However, in some occasions, *M. incognita* occurred as the pure population. Incidence of *M. javanica* was not detected in Mugunuwenna. High percentage root galling was detected on Mugunuwenna indicating potential interference with the shoot growth.

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448/D

### Avifaunal species richness and diversity at the Giritale nature reserve of North-Central province, Sri Lanka

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A study on avifaunal species richness and diversity of the Giritale Nature Reserve of North-Central Province, Sri Lanka was carried out from March 2006 to February 2007. Three line transects (length 750m each) were marked using a global positioning system per habitat in four different habitat types. Variable Circular Plot (VCP) method (Reynolds et al. 1980) was used to survey the birds. Hundred and seven avifaunal species were recorded during the study period. These included three migratory bird species, Forest wagtail (*Dendronanthus indicus*), Barn swallow (*Hirundo rustica*) and Indian pitta (*Pitta brachyura*). The eight endemic species, recorded were Crimson-fronted barbet (*Megalaima rubricapilla rubricapilla*), Sri Lanka junglefowl (*Gallus lafayettii*), Sri Lanka grey hornbill (*Ocyrceros gingalensis*), Pompadour green pigeon (*Treron pompadora pompadora*), Brown-capped babbler (*Pellorneum fuscicapillum*), Indian Scimitar-babbler (*Pomatorhinus horsfieldii melanurus*), Black-headed yellow bulbul (*Pycnonotus melanicterus*) and five threatened species. The total number of birds recorded was highest in the shrub lands with 1279±328.81 (Mean±SD) birds and the lowest number of birds was recorded in the tank habitat with 576±147.71 (Mean±SD) birds. Forest habitat had 818±209.48 (Mean±SD) birds and the man made habitats had 1122±287.85 (Mean±SD) birds. December had the highest avifaunal population of 501 birds and June 2006 had the lowest avifaunal population of 106 birds. Avifaunal population and species diversity for the period of March 2006 to August 2006 was significantly low 3.17±0.07 (Mean±SD) compared to the period from September 2006 to February 2007, 3.41±0.05 (Mean±SD), (t= 4.239, p<0.01, df=5). Highest species richness of 69 was recorded in the man made habitats followed by the shrub-lands (S=63) and forests (S=58). Lowest species richness of 37 was observed in the tank habitat. However, the Shannon Weiner

evenness (J) was highest in the tank habitat (J= 0.86) and was lowest in the man made habitats (J= 0.74). Relative abundance and indicated that Red-vented bulbul was the most common avian species followed by the Spotted dove. Since the Giritale Nature Reserve provides a suitable habitat for hundred and seven avian species including eight endemic species and five threatened species every effort should be taken by the management to preserve this prime habitat for birds.

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## SECTION E1

### 501/E1

#### **An analysis of a non-replicated three-factor experiment using some improved methods**

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Three-mode data pertain to measurements related to three factors or “modes”. An important objective of any analysis of such data is to examine the interaction between these three factors simultaneously, as the interpretation of results is based on the presence or absence of this interaction. When independent replications are present for each combination of the three factors, usual method of analysis through ANOVA can be used to test the presence of three-factor interaction. When the experiment is non-replicated, the usual method fails. Out of several approaches, the most general approach that considers three-factor interaction simultaneously in such cases is the Tucker3 analysis. Tucker3 analysis alone is an exploratory approach. As a confirmatory approach, a method is available for testing for three-factor interaction in sub-areas of non-replicated three-factor experiments based on Tucker3 model. However, this method utilizes results of an approximate likelihood ratio test.

A MATLAB program is developed to simulate the exact null distribution of the above likelihood ratio statistic for limited cases. This exact approach can be used for testing three-factor interaction in sub-areas of three-way data under a single component Tucker3 model. The method is illustrated using data previously analyzed based on approximate results, now with the help of critical values generated from exact results. For this data set the results from the approximate method and the exact method agreed with each other. However, this may not be the case with larger data sets.

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### 502/E1

#### **Proposal for a student selection method for university admissions in Sri Lanka**

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According to the current admission policy students can select three subjects in any one particular stream for their GCE (A/L) examination, based on their GCE (O/L) examination results and their preferences. The Z Score system has been introduced to select students to universities by adjusting different difficulty levels of the subjects they offered at the examination. However it has now been identified that there are ambiguities in the Z Score system. This study aims to develop an improved method to Z Score system to select students who offer different subject combinations at the GCE (A/L) examinations for admission to Universities in Sri Lanka. It is a fact that intelligent students select competitive subjects in GCE (A/L) examination while less intelligent students select easy combinations of subjects. Course contents and examination papers of the subjects they offer consist of many uncontrollable problems like different levels of difficulties, mistakes, unclear parts, examiner differences while marking etc. Nevertheless, these factors should not have any favorable or unfavorable effects on the student selection process. The selection should be performed independent

from those factors, which are beyond the control of students. The objective of this study is to propose a selection method, named as Common Currency Index (CCI) Method, which has been designed to eliminate all the above problems as far as possible. In this method different course wise marks are converted to one type of course marks, similar to conversion of currency. Once all the marks are converted, selections can be performed following the usual procedures. In this method students will not experience discrimination due to selection either from within a course or between courses with different subject combinations. This new method was tested using simulations. Further it was revealed that it is an improved method to the currently used Z score method.

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### **503/E1**

#### **Sexual behaviors and knowledge of HIV/AIDS/STDs of the plantation workers in upcountry estates of Sri Lanka**

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The social and economic consequences of the epidemic HIV/AIDS are devastating, with the loss of parents and wage earners. The number of HIV/AIDS cases in Sri Lanka is still relatively low, but extensive HIV risk factors are prevalent. Without vigorous action to prevent the spread of HIV infection, Sri Lanka runs the risk of developing an AIDS epidemic.

Studies on monitoring the current state of affairs within different communities are of a great need in developing strategies on prevention of this epidemic. This study focuses on such aspects, and is based on a survey conducted by the HIV/AIDS/STD Control Programme in Sri Lanka. The survey was targeted on the plantation workers in upcountry estates of Sri Lanka in assessing their life style, sexual behaviors and knowledge of HIV/AIDS and Sexually Transmitted Diseases (STDs). The sample of 594 plantation workers was selected to represent the entire plantation sector in upcountry estates of Sri Lanka using a two-stage cluster sampling technique.

Throughout the study, the survey data are subjected to several statistical analyses, in order to fulfill the aspects of monitoring the level of knowledge and behavioral characteristics of the plantation workers.

The study consisted of a preliminary analysis and two different modeling approaches, namely ordinal logistic regression for modeling the response-knowledge of HIV/AIDS and log-linear models that illustrate the significant associations between the socio-demographic and behavioral characteristics of the respondents.

There were some significant findings that emerged during the entire analysis. Male plantation workers were found to be more vulnerable than females yet they have a higher knowledge and better use of condoms. The young age groups were relatively in a better position compared to elders regarding the level of knowledge of HIV/AIDS and STDs. The condom use of plantation workers was not at a satisfactory level. A proper education and exposure to mass media seems influential on improving the knowledge of the respondents regarding HIV/AIDS and STDs.

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504/E1

### Formal verification of ez-reload SMS protocol using SPIN

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The ez-reload is a Short Message Service (SMS) protocol offered by Dialog Telecom Ltd to reload the Keep In Touch (KIT) mobile package users. KIT is a pre-paid package, where the user has to subscribe before obtaining Dialog Telecom services. In the ez-reload system, Dialog Telecom has agents appointed island wide, from whom KIT subscribers can get their mobile phone re-loaded by simply paying the amount to reload. Once the payment is made, the agent will send a SMS containing the subscriber's mobile phone number and the amount paid to Dialog Telecom. Finally, Dialog Telecom will send a SMS to both the agent and the KIT subscriber confirming that the payment has been credited to the KIT subscribers account.

The research goal was to find out whether the ez-reload SMS protocol was reliable and if not propose modifications the ez-reload protocol. For this purpose it was checked whether money atomicity, goods atomicity and validated receipt properties were exhibited by the protocol. The model checking tool, Simple Promela Interpreter (SPIN) was used to model the ez-reload protocol. The behavior of the subscriber, agent and Dialog Telecom were modeled as Promela processes. The money atomicity, goods atomicity and validated receipt properties were modeled as Linear Temporal Logic (LTL) formulae. When SPIN tool was run in verification mode against LTL formulae it showed that the ez-reload protocol does not exhibit both money atomicity and goods atomicity properties under communication channel loss scenario. Additionally under normal operating conditions validated receipt property is also not exhibited.

Introducing a new SMS message for the subscriber, which gets a reference number for the transaction, eliminated the validated receipt property violation. This reference number is used by the parties to the transaction when sending SMS messages. Both money and goods atomicity property violations were eliminated by introducing another SMS message named BILL for the agent and the subscriber. When the BILL SMS is send to Dialog Telecom, it gives the last payment details for the subscriber. The said modifications were modeled and the SPIN tool was used to formally show that the modified ez-reload protocol has money atomicity, goods atomicity and validated receipt properties.

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505/E1

### Adapting particle movement models to mobile device connectivity patterns

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This study attempts to model the stochastic behavior of movements of mobile in an adhoc network environment. For this purpose pair-wise contact duration as well as the inter-contact time of mobile ad-hoc devices are obtained from a practical scenario. The objective is to find the probability distributions and the characteristic behavior of contact times and inter-contact times of these mobile devices that were observed. This leads to an insight into how probabilistic data dissemination occurs in such an environment.

The study uses the mobility traces, which are available in CRAWDAD [1]. Among the characteristics of these mobile ad-hoc devices are the non-infrastructure property, the peer-to-peer connectivity manner, and the content distribution while in close proximity to each other. Statistical packages such as SPSS, SAS and Minitab were used to analyze the traces. Descriptive statistics, graphical methods and diagnostic checks had been used based on the plausibility of the statistical model assumptions. The Gauss-Markov model [4] is currently being used as a synthetic model and the model to be developed would be tuned for these mobile traces. A mathematical model will be derived for the mobile connectivity once the tuning is complete.

The study revealed that the mobility traces defer from the established distributions and their characteristics. The contact durations depict a near exponential decay, but not exactly as the statistical test reveals. When observed using the other intervals the contact durations exposed a certain degree of log normality, especially when the durations were increased. This could be due to the Gauss Markov property. So the simulation process was tested to fine-tune the parameters of the Gauss-Markov model to fit the distribution of mobility traces. Inter-contact times were also seen to deviate from the defined distributions. For the given practical scenario, the mean inter-contact time is around 2 hours and 19 minutes with a recurring pair-wise contact probability of 0.8.

Simulated traces set showed very much identical pattern to the Cambridge traces set. It confirms that the lognormal property holds for separate intervals for connection duration distribution at expanded intervals. Also, the simulation produced close results for the CCDF for inter-contact times indicating that the real life mobility scenario nearly follows a Gauss-Markov model.

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**506/E1**

### **Identification of mechanisms of excitation, charge transfer and ionisation in classical proton–hydrogen atom collisions in two dimensions using divisions in phase space**

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Thermal reactions are due to atomic and molecular collisions. Hence, a theoretical study of product formation in atomic collision processes constitutes a first step in understanding the detailed dynamics of chemical reactions. Quite often the simplest of such systems, viz. *bare nucleus–hydrogen atom* (three body) collisions, are studied in developing concepts associated with such processes and in testing new approximate theories. Such collisions lead to three types of outcomes, viz. excitation, charge transfer and ionization.

In the recent past attention has been focused in studying the said collision system using classical mechanics. In Classical Trajectory Monte Carlo method the quantum nature of the electron dynamics is incorporated by running a large number of trajectories. Trajectories are generated by numerically integrating the relevant Hamilton's equations. The dynamics of particles during the collision process can be studied in phase space. Such a study provides intriguing insights to the product formation process. In this context it is useful to examine such collisions in reduced dimensions. We have studied planner  $H^+ + H(1s)$  collisions (where the electronic phase space is four dimensional) in the internuclear velocity range  $v = 1.09 \times 10^6 \text{ ms}^{-1}$  (0.5 a.u.) to  $v = 6.56 \times 10^6 \text{ ms}^{-1}$  (3.0 a.u.) in order to

device a method to identify different mechanisms of excitation, charge transfer and ionization based on division of the phase space and use it to identify different mechanisms.

At all velocities, we have established the existence of a finite number of regions in the electronic phase space, where the phase points in each region lead to the same outcome. The number of such regions associated with each outcome, viz. excitation, charge transfer and ionization, is distinct. Also, the extent of different regions leading to the same outcome is different in general. Each region represents a distinct mechanism of producing the associated outcome. Thus we have established a method to identify the mechanisms of product formation in  $H^+ + H(1s)$  collisions in two dimensions and used it to recognise the mechanisms in that collision system. This method can be easily extended to other bare nucleus–hydrogenic atom/ion collisions.

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**507/E1**

### **Measurement and evaluation of road traffic noise levels**

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A study was carried out to determine the existing road traffic noise levels in category A, B and C grade roads. A total of 5 separate locations, each with different traffic conditions were selected for this work. Noise measurements were carried out approximately 5 m from the edge of the traffic route and 1.5 m above the ground level. In each location, noise measurements were taken for a duration of 13 hours on weekdays categorized as, early morning (6 a.m. – 8 a.m.), late morning (8 a.m. to 12 noon), afternoon (12 noon to 4 p.m.), evening (4 p.m. to 7 p.m.) and night (7 p.m. to 9 p.m.). Several noise level descriptors were measured simultaneously. Questionnaire was given to residents in the same locations to assess their perception towards noise disturbances.

It was observed that average noise levels ( $L_{90}$ ) reached above 55 dB (A) if the number of vehicles exceeds 1000 vehicles per hour. When number of vehicles falls below 500 vehicles per hour, average noise level stays below 50 dB(A). For category A roads noise, levels stays above 55 dB(A) where as for category C roads the same was below 50 dB(A) throughout the day. The composition of vehicles showed that heavy vehicles such as lorries and containers contribute significantly to the average noise levels in category A roads. For category B and category C roads, very light vehicles, such as motorbikes and three wheelers contribute to the average noise levels heavily.

Survey results shows that a-weighted equivalent noise level ( $L_{Aeq}$ ) exceeds 60 dB(A) excluding nighttime at category B and C roads. The equivalent noise levels in Colombo–Kandy main road (category A) exceeds 72 dB(A) including the nighttime.

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508/E1

**Radial velocity study of close binary star - S Ant using 45 cm Cassegrain telescope at Arthur C Clarke Institute**

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The binary star system S Antlia, period 0.648 days, spectral type A9(Vn),  $m_v = 6.4$  is classified as a double – line spectroscopic binary and such a double line spectroscopic binary has never been studied on the 45cm telescope at ACCIMT before. Though S Ant has been a target for several photometric studies in the past it has only been studied in spectroscopy twice. Therefore it is very important to study this system in spectroscopy.

From the observed H alpha line profiles, we noticed that the observed H alpha line profiles have been distorted significantly. Since  $H\alpha$  is not a pure photospheric line it could reflect the motions of H gas streams in the contact binary system envelop. As the spectrum of the secondary is weak compared with that of the primary and has been blended with the spectrum of the primary it is very difficult to resolve them. We have used several deblending tasks in IRAF to separate them. We have also tried to find out the broadening functions of the system. But not succeeded. Since this contact binary system has a short period we can't use long exposure time to obtain a high S/N ratio in our spectra due to the smearing of spectral lines with Doppler broadening. Therefore the secondary component is not resolvable with the ACCIMT telescope.

The radial velocity values between phases 0.5 and 1.0 are similar to that of given in the previous studies and the velocity values of the rest of the phases are highly deviated from the accepted values. The moving gas streams from primary to secondary could alter the H alpha line profile significantly. In order to verify this, we observed purely photospheric lines Fe(I) 5167.49 °A and Al(II) 5285.85 °A from phase 0 to 0.5. We found that the radial velocity values obtained from these photospheric lines are tally with the values given in the previous studies. We calculated the amplitudes of the velocity curve of the primary component from phase 0.5 to 1.0 and from phase 0 to 0.5 separately. The observed primary amplitudes at phase 0.75 and 0.26 are found to be  $83 \pm 18$  Km/s and  $-84 \pm 18$  Km/s respectively. These values are comparable with the previously observed radial velocity value, 77 km/s. Since the error given by IRAF is very small, the RMSE given by MATLAB was taken as the standard error.

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509/E1

***Effect of solar activity on weather changes and occurrence of extreme event cyclones***

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Variation of radiation emitted from the sun can affect the weather parameters. This paper describes an attempt made to understand the influence of solar activity on weather pattern in and around Sri Lanka surrounded by the vast Indian Ocean. Sunspot number was used as an indicator of solar

activity. Atmospheric temperature and the occurrence of extreme weather event cyclones were considered to understand weather changes within a limited scope.

Annual mean temperature was calculated using monthly atmospheric temperature data collected from thirteen Meteorological stations in Sri Lanka over a period of hundred and ten years from 1870 to 1980. Sunspots data were obtained from international solar observation projects NOAA and SOLAR.

Correlation coefficient between atmospheric temperature and sunspot number was calculated and found to be 0.1 in short term (monthly) as well as long term (annually) periods. The existence of no significant correlation between the solar activity (which is a global parameter on temperature) and atmospheric temperature in Sri Lanka can be attributed to the greater influence of local effect of the vast ocean around the island than the solar activity.

The second part of the study was focused to understand the influence of solar activity on cyclones affecting Sri Lanka. Out of the fourteen cyclones that crossed over Sri Lanka during the period 1900 to 1980, nine have crossed over the island during the period 1900 to 1932 and the rest during the period 1964 to 1980. In order to understand this, the temperature differences between annual mean temperature on the years having maximum sunspots and subsequent years having minimum sunspots was calculated. Results indicate that when the difference is negative ( $-0.3^{\circ}\text{C}$  for the period 1900 to 1932 &  $-0.1^{\circ}\text{C}$  for the period 1964 to 1980) cyclones are crossing over Sri Lanka, and when the difference is positive (difference vary from  $0.5^{\circ}\text{C}$  to  $0.1^{\circ}\text{C}$  during the period 1933 to 1954) cyclones originated in the Indian Ocean do not cross over the island. This criteria can be adopted after further verifications to identify potentially hazardous cyclone prone years to Sri Lanka and thereby in better disaster management.

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**510/E1**

### **Electron kinetics study of dye-sensitized solar cells made from MgO coated SnO<sub>2</sub> nanocrystalline films**

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The studies on Dye-sensitized nanocrystalline photovoltaic solar cells (DSNCs) widen the horizons of the low cost alternative photovoltaics and arouse the fundamental research interests of the investigators. A DSNC fabricated by SnO<sub>2</sub> crystallites coated with ultra thin layer of MgO (MgO/SnO<sub>2</sub>) has been reported to deliver a high open circuit photovoltage comparable to the DSNCs fabricated only with SnO<sub>2</sub> crystallites. The photo excited dye molecules adsorb on the MgO outer layer suppose to inject electrons into the conduction band of SnO<sub>2</sub> via tunneling through the MgO barrier. Suppression of recombination of electrons in the conduction band with the dye cations and the acceptors at the electrolytic interface build up the quasi-fermi level of SnO<sub>2</sub> resulting increase in the photovoltage. The competition between the back ward reactions and the collection of electrons at the substrate is determine by the electron diffusion length  $L_n = (D_n \tau_n)^{1/2}$  where  $D_n$  is the electron diffusion coefficient and  $\tau_n$  is the carrier lifetime. Though the increment of photovoltage and the efficiency is interpreted as a consequence of the blocking layer, no previous research has been done to study the electron kinetics of this cell. We have conducted some studies to analyze  $D_n$  and  $\tau_n$  of the electrons injected to MgO/SnO<sub>2</sub> DSNC using intensity modulated photocurrent (IMPS) and intensity modulated photo voltage (IMVS) spectroscopy.

MgO/SnO<sub>2</sub> film was deposited on a conducting tin oxide (CTO) glass by the following method. 7 mg of MgO was grinded in a mortar with few drops of acetic acid and 2 ml of Tin oxide Colloid. This solution was diluted with ethyl alcohol and spray onto the CTO glass at 120 °C. After depositing the film it was sintered in a furnace at 500 °C for 30 minutes. These films were kept immersed in a ruthenium bipyridyl dye in alcohol for one hour. The cell was fabricated by placing a CTO glass coated with Pt on the film and filling the capillary space with an electrolyte containing I<sup>-</sup>/I<sup>3-</sup> redox couple. A similar procedure is followed to construct DSNCs of bare SnO<sub>2</sub>, except the addition of MgO in the preparation. Intensity modulated photovoltage spectroscopy (IMVS) and Intensity modulated photocurrent spectroscopy (IMPS) measurements were carried out using a blue light emitting diode ( $\lambda_{\text{max}}=470\text{nm}$ ) driven by a frequency response analyzer. The LED provided both the dc and ac components of the illumination.  $D_n$  and  $\tau_n$  were calculated from the minima of the IMVS and IMPS curves respectively at different intensities.

The lifetime of electrons decreased with the increment of light intensity for both SnO<sub>2</sub> and SnO<sub>2</sub>/MgO cells but the lifetime of the electrons in SnO<sub>2</sub>/MgO film is always higher compared to bare SnO<sub>2</sub> cell. The diffusion coefficient increases as the light intensity increases where the diffusion coefficient is also higher at any particular light intensity for SnO<sub>2</sub>/MgO cell. Since both the  $D_n$  and  $\tau_n$  are greater, diffusion length of electrons in SnO<sub>2</sub>/MgO cells is large. Nevertheless electrons transport efficiently and recombination losses are minimal in the DSNC constructed with MgO coated SnO<sub>2</sub> film that claim for the high photovoltage and efficiency. This is a different approach to interpret the enhancement of high voltage and efficiency previously reported on the SnO<sub>2</sub>/MgO dye-sensitized solar cells.

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511/E1

### **Comparison of dye-sensitized photo electrochemical cell and solid-state cell: Studies of charge transport and carrier lifetime**

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Dye-sensitized solar cell is a low cost alternative to the silicon base solar cell, which draws much attention during the past decades. It composes of a nanocrystalline mesoporous metal oxide semiconductor film deposited on conducting tin oxide (CTO) glass, which is coated with a dye. The charge transport media at the dye interface is generally an electrolyte, which causes many technological problems such as liquid evaporation, sealing problems etc. Scientists search for solutions to these problems replacing the electrolyte with a p-type semiconductor, which they thought would solve all these problems. But, because of the lack of a strong charge inversion layer, recombination is crucial at the dye semiconductor interface of the solid state cell. Therefore the expected efficiency could not be achieved with the dye sensitized solid state solar cell comparable to the photoelectrochemical solar cell. In this study we have calculated the carrier lifetime and the diffusion coefficient of electrons in the two types of solar cells for comparison using intensity modulated photovoltage spectroscopy (IMVS) and intensity modulated photocurrent spectroscopy (IMPS) respectively.

The techniques of depositing the TiO<sub>2</sub> films on the CTO glass are different for the two types of solar cells. TiO<sub>2</sub> film for the dye-sensitized electrochemical solar cell is made by coating a TiO<sub>2</sub> past by doctor blade technique on CTO glass which was made grinding Degussa powder with acetic acid and distill water and then sintering at 500 °C in a furnace. The TiO<sub>2</sub> film for solid-state cell is made by spreading a colloidal solution prepared by hydrolysis of titanium isopropoxide in propanol several times on CTO glass and sintering after the each coating at 500 °C. Both the films were coated with ruthenium bipyridyl dye by immersing the films in dye solutions. The fabrication of the electrochemical cell is done by placing a Pt coated CTO glass on the dye coated surface of the film and filling the capillary space with an electrolyte with I<sup>-</sup>/I<sup>3-</sup> redox couple. Solid-state dye-sensitized solar cell is fabricated by coating copper iodide on the dye coated film by dissolving CuI in acetonitrile and applying the solution with a dropper and allowing to dry. IMVS and IMPES measurements were carried out using a blue light emitting diode ( $\lambda_{\text{max}} = 470 \text{ nm}$ ) driven by a frequency response analyzer. The LED provided both the dc and ac components of the illumination. The intensity of the LED was measured using a lux meter.

The electron lifetime calculated with the IMVS measurements were always large values for photoelectrochemical solar cell. The reason could understand as the low recombination of photo generated electrons in dye sensitized electro chemical solar cell compared to the solid state cell. But when the diffusion coefficient is calculated from the MIPS measurements the diffusion rate is high in the solid state dye-sensitized solar cell. The interfaces of the dye is different in two types of solar cells where a p-type semiconductor in solid state cell and electrolyte in the electrochemical cell. We cannot totally reject the presence of depletion layer in the dye-sensitized solid state solar cell similar to the photoelectrochemical cell. That is because of the observed rectification action in solid state cell. Therefore this build in electric field would force the electrons to diffuse faster in the dye-sensitized solar cell. This kind of electron kinetic studies will help to understand the operation of the dye-sensitized solid state solar cell intensively that help to develop it as a viable device.

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512/E1

### **Synthesis and characterization of lanthanum gallate electrolyte materials for the intermediate temperature solid oxide fuel cell**

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Development of better oxygen ion conducting electrolyte materials with high electrical conductivity and stability is very essential for the electrolyte of Intermediate Temperature Solid Oxide Fuel Cell (IT-SOFC), which operates at 500 - 800 °C. Sr and Mg doped lanthanum gallate (LSGM) ceramic, having an appropriate perovskite structure, is considered as promising candidate for the electrolyte of the IT-SOFC. However, synthesizing of pure LSGM phase is still facing a challenge. Our work on development of LSGM electrolyte materials for the IT-SOFC, mainly focuses on finding appropriate synthesis procedures and the effect of dopants on the LSGM phase.

This paper presents the synthesis and electrical characterization of La<sub>0.85</sub>Sr<sub>0.15</sub>Ga<sub>0.85</sub>Mg<sub>0.15x</sub>Ni<sub>x</sub>O<sub>3-s</sub> (x = 0 - 0.15) material compositions. The new materials in the form of fine powders were synthesized by stearic entrapment synthesis (SES) method by calcining at 1200 °C for 5 h in static air. The synthesized powders were then palletized and sintered at 1450 °C for 5 h in air, in order to get dense solid materials. The phase analysis on them was performed by X-ray diffractometry and the electrical conductivity measurements by the complex impedance method up to 700 °C.

All the prepared  $\text{La}_{0.85}\text{Sr}_{0.15}\text{Ga}_{0.85}\text{Mg}_{0.15-x}\text{Ni}_x\text{O}_{3-s}$  ( $x = 0 - 0.15$ ) materials in this study show the existing of only the appropriate lanthanum galete perovskite phase. Further the electrical conductivity of the  $x=0$  material synthesized in this study is considerably higher than those prepared with other synthesis methods. Altogether, this study reveals the ability of SES method to synthesize pure LSGM materials with improved electrical conductivity. The new compositions prepared with doping LSGM with Ni, show the ability of increasing the electrical conductivity while preserving the appropriate preovskite crystal structure of the material. Further, the pure electronic nature of  $x=0.15$  material together with its similar crystal and chemical structures as of LSGM ( $x=0$ ) electrolyte material, indicate the potentiality of using  $x=0.15$  as a candidate material to the IT-SOFC electrodes. With the expected minimal disparity at the interface between electrolyte and electrodes with these materials, this finding could open a new direction in the materials research on IT-SOFC.

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### 513/E1

#### **Synthesis and electrical characterization of Fe and Al doped $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$ for lithium ion rechargeable battery cathodes**

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Li-ion batteries (LIB) undeniably represent the most promising energy storage system among the portable sources of energy and certain aspects of its principles of operation deserve particular attention. Though  $\text{LiCoO}_2$  has most widely been used for the cathode of Li-ion batteries, now  $\text{Li}(\text{Ni}_y\text{Co}_{1-2y}\text{Mn}_y)\text{O}_2$  material systems (R3m layered structure) are extensively being studied to replace costly  $\text{LiCoO}_2$ . In this system,  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$  has extensively been investigated, because of its superior electrochemical performance and safety with compared to  $\text{LiCoO}_2$ . This abstract presents a study of synthesis and electrical characterization of new material compositions prepared by substituting Co, in  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$  with Al and Fe.

New material compositions in two systems,  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{(1/3-x)}\text{Mn}_{1/3}\text{Fe}_x)\text{O}_2$ , ( $x=0.00, 0.11, 0.22, 0.33$ ) and  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{(1/3-x)}\text{Mn}_{1/3}\text{Al}_x)\text{O}_2$ , ( $x=0.00, 0.11, 0.22, 0.33$ ) were synthesized in the form of fine powders by Pechini method by calcining at  $900\text{ }^\circ\text{C}$  for 4 h. The calcined powders were then pelletized and sintered at  $1000\text{ }^\circ\text{C}$  for 4 h. The phase and particle size analyses were carried out on calcined powders with X-ray diffractometry and a particle size analyzer, respectively. The a.c. impedance, Seebeck and d.c. (four probe method) electrical characterizations were performed on the sintered pellets.

The phase analysis revealed the formation of solid solutions of appropriate  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$  phase (R3m layered structure) in the materials doped with Fe and Al content up to 0.11. The electrical conductivity of most of these materials is in the order of  $1 \times 10^{-4}\text{ S/cm}$  at  $25\text{ }^\circ\text{C}$  and  $1 \times 10^{-2}\text{ S/cm}$  at  $200\text{ }^\circ\text{C}$ , and much better than that reported for  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$ . The electrical conductivity of Fe doped system increases with Fe content up to  $x=0.11$ , then decreases significantly, but even at  $x = 0.22$ , the conductivity is still higher than that of  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$ . Conversely, conductivity of Al doped system decreases with Al content, indicating that the Al doping in  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$  has adversely affected the electrical conductivity. All these materials prepared by Pechini method show of having appropriate particle size for LIB cathodes. Altogether, this study shows potentiality of, specially Fe doped  $\text{Li}(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{O}_2$  materials prepared by Pechini method, for Li-ion battery cathode application.

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514/E1

### **Soluble Thiophene and Furan based functionalized conducting polymers for sensitization of TiO<sub>2</sub> in dye sensitized solar cells**

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Dye Sensitized Solar Cells (DSSCs) have been developed as an alternative to solid-state silicon-based cells for the conversion of solar energy into electricity. DSSCs uses a mesoporous nanocrystalline n-type semiconductor layer, such as TiO<sub>2</sub> deposited on a transparent conducting glass plate (FTO), with an attached dye to collect sunlight, and it acts as a photo-anode. The cathode is a liquid electrolyte containing a redox couple Iodide/triiodide and platinum or a gold plate usually acts as the counter electrode to enhance the electrical contacts. One major problem associate with DSSCs is the use of expensive and long-term unavailable ruthenium complexes as sensitizer dyes. As an alternative for these expensive dye complexes, conducting polymers (CPs) have attracted much attention, due to their low cost and easy synthesis using readily available starting materials.

By keeping this in mind, we successfully synthesized Poly(3-hydroxy-3-thiophen-3-yl-propionic acid)-P3H3TPA and Poly(3-furan-3-yl-3-hydroxypropionic acid)-P3F3HPA both containing two functional groups; carboxylic acid and hydroxyl. Both polymers were readily soluble in ethanol and therefore easy to process.

DSSCs were fabricated using those two polymers and TiO<sub>2</sub> and the type was FTO/TiO<sub>2</sub>/Polymer/Electrolyte/Pt. Their performances were measured under simulated sunlight of 100 mW cm<sup>-2</sup> (Air Mass 1.5). The cells sensitized with P3H3TPA generated a short-circuit photocurrent ( $J_{sc}$ ) of 0.776 mA cm<sup>-2</sup>, an open-circuit voltage ( $V_{oc}$ ) of 352 mV with a fill factor (FF) of 61% and an overall efficiency ( $\eta$ ) of 0.166%. While the cells sensitized with P3F3HPA generated  $J_{sc}$  of 0.428 mA cm<sup>-2</sup>,  $V_{oc}$  of 391 mV, FF of 67% and  $\eta$  of 0.112%. A significant enhancement of the cells was observed for both polymers after addition of an ionic liquid (1-methyl-3-n-hexylimidazolium iodide) in to the electrolyte. For P3H3TPA the values obtained for the above polymers were 0.884 mA cm<sup>-2</sup>, 351 mV, 60%, 0.185% respectively while for P3F3HPA they were 0.528 mA cm<sup>-2</sup>, 386 mV, 68%, 0.137% respectively.

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515/E1

### **Polymer photovoltaic devices by blending with ionic solid electrolyte**

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Organic solar cells show great promise as a low cost alternative to inorganic semiconductor-based photovoltaic devices. Though they give very small currents these too come in handy for devices such as small calculators, clocks, thermometers etc., where the only obstacle will be the lifetime. In this paper we describe results obtained from a systematic study of polymer photovoltaics based on blends composed of poly[(2-methoxy-5-ethylhexyloxy)-1,4-phenylenevinylene] (MEH-PPV) and [6,6]-phenyl-C<sub>61</sub>-butyric acid methyl ester (PCBM), poly(3-hexylthiophene) (P3HT) and PCBM bulk-heterojunction cells sandwiched between a polymer electrolyte made of either Polyacrylonitrile (PAN), or Polyethylene oxide (PEO), having different compositions together with a Pt counter electrode. Changes in device performance with the addition of acetonitrile to the electrolyte have also been discussed, and their values taken in to consideration herein.

The current-voltage characteristics in the dark, under white light illumination, absorbance parameters of the respective films in the 1:4 blend concentrations, and the best IPCE% of the device with the best combination were studied. The life time of these devices were also studied. An open circuit voltage of 448 mV with a 0.063 mA/cm<sup>2</sup> short circuit current was obtained for the device containing P3HT in the blend and (PAN) with acetonitrile in the electrolyte. Where an open circuit voltage of 449.3 mV with a 0.056 mA/cm<sup>2</sup> was obtained to the device having the same electrolyte but MEH-PPV as the polymer in the blend.

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## SECTION E2

601/E2

### **Moss (*Barbula* sp.) as a bioindicator of monitoring heavy metal air pollution around Sapugaskanda industrial area in Sri Lanka**

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The moss *Barbula* sp., a species found to absorb heavy metals from atmospheric deposition more effectively compared to some other moss species found in Sri Lanka, was used as a bioindicator for the estimation of atmospheric heavy metal deposition around the industrial area of Sapugaskanda (Kelaniya, Sri Lanka), which includes an oil refinery, an industrial zone and three power plants. Background level was determined from the data obtained from two remote sites, Kosmulla (Sinharaja boarder village) and Nikapitiya (Kegalle) distance greater than 100 km from the study area where anthropogenic influence is very low. For comparison purpose a site close to the Fort railway station was selected as an urban area. Atomic Absorption Spectrophotometry (AAS) determined bioaccumulation of heavy metals (Pb, Ni, Cu, Cd and Cr) in moss during six months of period from August 2006 to January 2007.

Heavy metal concentrations measured in all the sampling sites during six months period is given in  $\mu\text{g/g}$  dry weight. Generally, the highest values were measured close to the sources. For Pb and Cu the results showed very similar patterns with extremely high values in the immediate surroundings of the industrial area. Ni showed somewhat different pattern, but still pointing to local pollution source. The highest Pb concentration was recorded close to the A1 road and Kelanithissa power plant where fossil fuel combustion is very high. The levels of metals at distance of about 8 km from the industrial site were still higher than in background samples. In general, the heavy metal concentrations in moss reflect the sources of emissions characteristic of the areas in which they occur and hence effects of the major pollution sources located in industrial zones could be readily detected on the basis of moss analysis.

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602/E2

### **Removal of chromium from aqueous solution by non-living biomass of *Cabomba* sp**

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Chromium occurs in several oxidation states ranging from  $\text{Cr}^{3+}$  to  $\text{Cr}^{6+}$  with trivalent and hexavalent states being the most common in terrestrial environment. It is widely deployed in various industries namely electroplating, dyes and pigments, textiles and photography and wood processing. Chromium is present in these effluents chiefly as Cr (VI), which is toxic and mutagenic for most organisms. Strong exposure of Cr (VI) causes cancer in digestive tract and lungs.

Both living and dead aquatic vascular plants play an important role in removing heavy metals. The main advantages of using dead biomass over of living plants are that problems of metal toxicity on plant metabolism, plant deterioration, odour liberation and insects proliferation are avoided, no additional nutrients are required and it involves low cost. The dried biomass also presents an advantage for conservation, transport, and handling and as such becomes ready for usage in wastewater units as simple sorbent material.

In this study, dried biomass of *Cabomba* sp was treated with varying concentrations of Cr (VI) solution and after eight days, the biomass was analysed using Atomic Absorption Spectrometer.

Experimental results showed that the removal efficiency of Cr (VI) by non-living biomass of *Cabomba* sp. decreases with increasing concentration of the test solution, showing the maximum % removal of Cr (VI) at an initial concentration of 3 ppm of test solution. These results show promise for the use of non-living biomass of *Cabomba* sp. for removal of chromium from polluted sites

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**603/E2**

### **Desorption of Paraquat in Sri Lankan soil types**

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The herbicide paraquat (1,1-dimethyl-4,4'-bipyridinium dichloride) has been widely used in agriculture over more than hundred countries as a nonsystemic contact herbicide for many crops. It is important to monitor the fate of pesticides in the environment (especially soil and water) due to the heavy use of pesticides in the world today. A major part of a paraquat application, when it reaches the soil, it is strongly adsorbed. This is in equilibrium with an extremely low concentration in soil solution. However, Paraquat in soil solution is biodegradable and completely mineralized by soil microorganisms. Research studies related to fate of paraquat have been reported extensively by other countries for their environmental and soil conditions.

Although Paraquat is a heavily used pesticide in Sri Lanka, fate of paraquat in the environment (soil and water) has not been conducted to the best of our knowledge. This study was under taken to explore this aspect. Quantitative laboratory scale experiments have been carried out to obtain preliminary data of fate of paraquat such as apparent Distribution co-efficient, adsorption isotherms. In addition, desorption behavior of paraquat molecules was also explored, under dynamic conditions using two different agricultural soil types in Sri Lanka (Batalegoda and Gannoruwa). Dynamic experiment was conducted for the soil type of Batalegoda using six glass columns ( diameter of 2 cm and height of 50 cm) filled with 100 g of soil (sieved and oven dried for 24 h at 100 °C ), the flow rates (0.10, 0.15, 0.20,0.30,0.38,0.50 cm<sup>3</sup> min<sup>-1</sup>) of water, which was added to measure the desorption amount of paraquat, were selected as desired. For the comparison purposes Apparent K<sub>D</sub> (  $K_D = \frac{[Paraquat]_{soil}}{[Paraquat]_{supernatant}}$  ) of paraquat on Bentonite clay was also investigated. Quantitation of paraquat accomplished by using stearic acid modified glassy carbon electrode as reported earlier.

Mean apparent partition coefficients found to be 8.48 and 11.95 for Batalegoda and Gannoruwa soil types respectively. The Apparent K<sub>D</sub> on bentonite clay was found to be 98.17. Furthermore, desorption quantity of the paraquat at water-saturated soil, was detected under six different flow rates

of water. It was found that more than 60% of paraquat could be eluted even at the slow flow rate of  $0.10 \text{ cm}^3 \text{ min}^{-1}$ . This study suggested that according to texture of Sri Lankan soil type, heavy water pollution is possible with paraquat.

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**604/E2**

### **Phytoextraction of lead in roadside sediments using selected legumes and composites – A model study**

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Our study was focused on using phytoextraction of Pb by *Pueraria phaseoloides* and *Tridax procumbens* as a potential method to treat contaminated roadsides. In modeled experimental conditions, the extraction of Pb by *Pueraria phaseoloides* and *Tridax procumbens* with the increase in soil Pb concentration was studied. The Pb accumulation of *Pueraria phaseoloides* and *Tridax procumbens* increased with the increase in soil Pb concentration. According to the study *Pueraria phaseoloides* and *Tridax procumbens* can tolerate up to 2000mg/kg and 1500 mg/kg soil Pb concentrations added as  $\text{Pb}(\text{NO}_3)_2$  respectively.

*Tridax procumbens* had shown higher Pb accumulation compare to *Pueraria phaseoloides* in same soil Pb concentrations. The Pb concentration of *Pueraria phaseoloides* and *Tridax procumbens* were 107.7 ppm (mg/kg of dry weight) and 158.5 ppm respectively, when the soil Pb concentration was 1500mg/kg. This observation shows that *Tridax procumbens* can accumulate about 50% more Pb compare to *Pueraria phaseoloides*.

*Pueraria phaseoloides* has relatively higher biomass. Germination of *Pueraria phaseoloides* seeds takes a longer time and they have a relatively longer lifetime however *Tridax procumbens* is an annual plant. Because of these reasons, use of *Pueraria phaseoloides* for the phytoextraction is more practical and hence economical.

Application of EDTA (1g/kg of soil) as an external chelating agent increased the amount of extracted Pb by *Pueraria phaseoloides* significantly. With EDTA (1g/kg of soil) added, the extracted Pb concentration in *Pueraria phaseoloides* was 313.0 ppm and in the absence of EDTA the extracted Pb concentration was 129.8 ppm, when the soil Pb concentration was 2000 mg/kg.

In our study it was also shown that electrodeposition techniques could be successfully used to recover the extracted Pb from the harvested *Pueraria phaseoloides* plants.

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**605/E2**

### **Relationship between total organic Carbon (TOC) & chemical oxygen demand (COD) in five different waste waters**

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The Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC) are two important parameters that are used to estimate the degree of organic material in the wastewater. The determination of COD is cumbersome, time consuming and generates toxic chromium waste. The operating cost is also high because of high cost of silver sulfate and consumes more electricity for heating. On the other hand total organic carbon measurement is rapid, easy and does not generate toxic waste.

A repeatable empirical relationship can be established between total organic carbon and chemical oxygen demand, so that total organic carbon can be used to estimate the accompanying chemical oxygen demand

The main objective of the study was to determine the relationship between Total Organic Carbon and Chemical Oxygen Demand for five treated effluents from five different factories. Samples were collected weekly for a period of 6 months from the five industries and analysed for COD & TOC. Synthetic samples of tris- hydroxymethyl methylamine were also analysed to determine the correlation. The correlation coefficient (r) determined by regression analysis of tris- hydroxymethyl methylamine was found to be 0.90. The correlation coefficient was also obtained for effluent from above industries. viz. 1) Thread dyeing  $r = 0.97$ , 2) Ayurvedic Herbal drugs processing  $r = 0.99$ , 3) Tourist hotel  $r = 0.98$ , 4) Fruits & Vegetables  $r = 0.98$  and 5) Garment washing  $r = 0.93$ .

The TOC and COD values varied with time in all five industrial effluents that were studied. However, the ratio (COD/TOC) remained the same. The ratios are mentioned below respectively:

1)  $3.3 \pm 0.4$  2)  $3.3 \pm 0.7$  3)  $4.4 \pm 0.4$ , 4)  $3.2 \pm 0.3$ , 5)  $2.9 \pm 0.7$ .

The correlation for each type of industry was therefore seen to be reliable. This suggests that TOC can replace COD to estimate the degree of organic pollution in the said industrial wastewaters for non-regulatory purposes such as designing treatment plants and monitoring pollution etc.

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**606/E2**

### **Thermodynamic parameters for the adsorption of chromate to the Kelani river suspended solids**

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Water bodies are polluted when substances like heavy metals enter the water way and alter their functions. Depending on the solubility, these metals may eventually become associated with suspended particulate matter and/or with the bottom sediments. Kelani River, the second largest watershed in Sri Lanka, flows through the most populated and economically administrative district and a large number of industries including tanneries, which utilize chromium, are developed along its shore. The effluents of these industries discharge to the river without any treatment. Hence the distribution of heavy metals in water and suspended solids (SS) in Kelani River was studied to see the adsorption pattern of these metals at different ionic strengths and pH through the complexation process.

Concentrations of heavy metals in river SS and water collected from locations having different characteristics were determined using flame and graphite furnace atomic adsorption spectrometry. It shows that the most of the heavy metals are associated with SS.

The adsorption density of chromate on 2g of Kelani river SS examined in batch experiments as a function of time at the pH of 6.12 by varying the initial chromate concentrations at  $1 \times 10^{-7}$ ,  $5 \times 10^{-7}$  and  $1 \times 10^{-6}$  mol dm<sup>-3</sup>, at a background electrolyte concentration of 0.010 mol dm<sup>-3</sup> NaCl showed that it increases with the initial concentration of chromate. When the amount of SS varied in the above experiment by keeping the initial concentration of chromate at  $5 \times 10^{-7}$  mol dm<sup>-3</sup>, the adsorption increased but the adsorption density decreased with the amount of SS as the adsorption density is reported per unit area.

The adsorption density of chromate on 2g of SS in the acidic conditions at pH of 4.12, at  $5 \times 10^{-7}$  mol dm<sup>-3</sup> initial chromate concentration and 0.010 mol dm<sup>-3</sup> NaCl background electrolyte has increased in the acidic medium. The chromate adsorption to SS was very poor in the basic medium of pH 9.00. The activation energy ( $E_a$ ), Gibbs free energy ( $\Delta G^\#$ ), entropy ( $\Delta S^\#$ ) and enthalpy ( $\Delta H^\#$ ) of the activation stage for chromate adsorption on Kelani river SS of Kelani estuary and upstream having different natural electrical conductivities were calculated by Arrhenius and Eyring models. Always  $\Delta S^\#$  values approximate to zero and  $-T\Delta S^\#$  values were positive, which indicates that the activation state of chromate adsorption process is entropy-controlled.

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**607/E2**

### **Effect of firing temperature of brick clay on defluoridation**

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Chemical properties of brick have been poorly characterized despite its strong ion-exchange properties, which can be used for many applications. Consequently, valuable properties of brick clay, raw or burnt, may not have become useful for chemical and/or industrial processes. Small particles of brick, owing to its ion-exchange and adsorption properties, can effectively be used in an economical and environmental friendly treatment manner for defluoridation. More importantly, increase in temperature of firing brick particles would allow some phase and chemical changes to occur, and hence surface area of brick particles, and nature and extent of processes that depend on surface properties would change with temperature.

The amount of fluoride ions (in µg) adsorbed on a unit mass (1 g) of laboratory fired brick clay samples ( $d < 1.0$  mm) varies with the initial concentration of fluoride in solution according to Type I adsorption isotherm for samples fired at temperatures up to 700 °C, above which Type II isotherm is valid. It is proposed that inner sphere complexes between fluoride and surfaces of minerals containing Fe, Al and Si present in brick form up to 700 °C, followed by outer sphere complexes above this temperature. The turbidity of suspensions of low fluoride ion concentrations is very low with brick fired at 300 °C to 600 °C. Moreover, the percent removal of fluoride ions by brick is high at intermediate temperatures followed by a decrease at high temperatures, indicating that brick particles fired at temperatures within the range specified above can effectively be used to defluoridate water contaminated with fluoride.

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608/E2

**Antifungal and antioxidant properties of alkaloids from *Xylopia championii* (Annonaceae)**

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The plant *Xylopia championii* Hook. f. & Thoms. (Annonaceae) is endemic to Sri Lanka. The antifungal and antioxidant activities of five alkaloids, oxopurpureine, (+)-laudanidine, (-)-discretine, nordicentrine and dehydrocorytenchine isolated from the stem bark and stem of *X. championii* were studied.

Alkaloid wash of the dichloromethane extract of the stem bark and stem of *X. championii* upon medium pressure liquid chromatography, flash chromatography and preparative thin layer chromatography yielded oxopurpureine and (+)-laudanidine. Crude alkaloids obtained from the methanol extract of the stem bark and stem of *X. championii* yielded three alkaloids; (-)-discretine, nordicentrine and dehydrocorytenchine.

All these five alkaloids were evaluated for their free radical scavenging activity using 1,1-Diphenyl-2-picrylhydrazyl (DPPH) radicals. At a concentration of 0.5 mg/1 mL (in methanol); the alkaloids, (+)-laudanidine (72.66 ± 0.45 %) and (-)-discretine (57.01 ± 0.17 %) exhibited high antioxidant activity while nordicentrine (11.41 ± 0.41 %) and dehydrocorytenchine (16.39 ± 0.22 %) showed moderate activity as compared to the standard antioxidant DL- $\alpha$ -tocopherol (55.84 ± 0.05 %) in the DPPH assay. All five alkaloids were subjected to the antifungal bioassay against *Cladosporium cladosporioides*. Nordicentrine showed the most potent antifungal activity at 6  $\mu$ g/spot while (-)-discretine showed moderate activity at 30.0  $\mu$ g/spot.

Structures determination of all compounds isolated from *X. championii* were carried out by detailed analysis of spectroscopic data (1D and 2D NMR, EIMS and UV) and with those reported for the compounds. They were found to be identical to those reported in the literature for these compounds.

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609/E2

**Alkaloids and diterpenoids of *Xylopia parvifolia* (Annonaceae)**

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The Annonaceae family is known as a rich source of aporphinoid and other isoquinoline type alkaloids. It also contains a number of non-alkaloidal natural products with interesting biological

activities. Annonaceae is a large family of tropical and subtropical trees and shrubs comprising about 120 genera and more than 2000 species. In Sri Lanka, the family Annonaceae is represented by 46 species distributed in 17 genera. *Xylopia parvifolia* (Wight) Hook. f. & Thoms. is a tree belonging to the family Annonaceae. In the literature there are no published reports regarding the phytochemistry or bioactivity of *X. parvifolia*. Six alkaloids namely, oxopurpureine, O-methylmoschatoline, (+)-laudanidine, (-)-discretine, nordicentrine and dehydrocorytenchine and two terpenoids *ent*-kaur-16-ene-19-oic acid and 15 $\beta$  hydroxyl(-)-kaur-16-ene-19-oic acid, were isolated from this plant.

Crude extract of alkaloids and isolated pure alkaloids showed no activity against second instar larvae of *Aedes aegypti*. However, *ent*-kaur-16-ene-19-oic acid and the extracts of *X. parvifolia* showed activity against second instar larvae of *A. aegypti*. The LC<sub>50</sub> values of *ent*-kaur-16-ene-19-oic acid were 7.33 ppm (at 24 h) and 3.28 ppm (at 48 h).

Alkaloid wash of the dichloromethane extract of the stem bark of *X. parvifolia* upon medium pressure liquid chromatography, flash chromatography and preparative thin layer chromatography yielded oxopurpureine, O-methylmoschatoline and (+)-laudanidine. Crude alkaloids obtained from the methanol extract of the stem bark of *X. parvifolia* yielded three alkaloids: (-)-discretine, nordicentrine and dehydrocorytenchine. Activity guided fractionation of alkaloid-free crude extract of dichloromethane extract of stem bark of *X. parvifolia* yielded *ent*-kaur-16-ene-19 oic acid along with a non-active compound 15 $\beta$  hydroxyl(-)-kaur-16-ene-19-oic acid.

Structures determination of all compounds isolated from *X. parvifolia* were carried out by detailed analysis of spectroscopic data (1D and 2D NMR, EIMS and UV). They were found to be identical to those reported in the literature for these compounds.

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## 610/E2

### Quality improvement of natural rubber latex through introduction of Aluminium hydroxide

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Consumption of rubber gloves, both examination and surgical, increased significantly from mid 1980's due to the spread of AIDS, mainly in Europe and in America. It is very well known that the best way of curtailing the spread of this disease, which is a blood and human body fluid assimilated disease, is by the use of rubber gloves and condoms.

It is also very well known that natural rubber based gloves are the best for this purpose and the synthetic rubber based gloves and condoms are not used for these purposes as they can not give the best feel to the user.

However, now there is a fear in Europe and USA that the use of NR based gloves constantly in contact with human tissues over a period of time can cause protein allergy, which can leads to even shock and death. Hens, although many attempt have been made to produce deproteinized centrifuged latex for these purposes, it has not been possible to do so yet commercially. In this project, Al(OH)<sub>3</sub> was used to deproteinize NR latex used in centrifuged latex industry. Addition of

Al(OH)<sub>3</sub> was carried out both prior to centrifuging and prior to vulcanization of the centrifuged latex produced, in order to measure protein content in the latex kjeldhal method was used.

According to results, in the sample studied %N was drop by 55.47 % in the sample where Al(OH)<sub>3</sub> was added prior to centrifuging in the concentration of 0.5 % w/w. But the same was only 38.1 % in the sample where Al(OH)<sub>3</sub> was added prior to vulcanization in the concentration of 0.5 % w/w.

In order to maintain latex properties at standard level, ISO standard test methods were used during this project work. It was observed during the process that the properties of latex were superior and was to the standard, where Al(OH)<sub>3</sub> addition was done prior to centrifuging. Further addition of Al(OH)<sub>3</sub> has no effect on the Ca<sup>2+</sup> and Mg<sup>2+</sup> ions in the latex.

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611/E2

**New insight into the control of the degree of hydrolysis and the determination of the percentage conversion in the production of poly (vinyl alcohol) from commercial poly(vinyl acetate)**

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Poly(vinyl alcohol) (PVA) is a water-soluble synthetic resin with excellent adhesive, film-forming and emulsifying properties. It is conventionally produced by the hydrolysis of poly(vinyl acetate) (PVAc). Alkaline hydrolysis of PVAc is preferred over the use of acid-catalyzed hydrolysis for the industrial production of PVA. Alkaline hydrolysis is carried out using sodium hydroxide (NaOH) and water or, more advantageously, by methanolysis employing sodium hydroxide and methanol.

Poly(vinyl alcohol) is suitable for a wide variety of applications, which are largely determined by its adhesive, film forming and emulsifying properties. Resin properties depend on the molecular weight of the parent PVAc and the degree of hydrolysis. By tuning the molecular weight of the parent PVAc and the degree of hydrolysis independently during the manufacturing process one can obtain the resin that provides the property balance needed for different applications.

In the study, partially hydrolyzed PVA was produced from commercial PVAc by alkaline hydrolysis in a water/methanol medium. Commercial poly (vinyl acetate) (48 %w/w) was treated with aqueous NaOH in methanol to afford PVA (74% yield) and the byproduct sodium acetate (CH<sub>3</sub>COONa).

Percentage conversion was determined by a titrimetric analysis of the byproduct sodium acetate with a standard 0.1 M HCl solution, which revealed that the PVA produced was 83 mol% hydrolyzed. The amount of alkali (NaOH) used in the reaction is the key factor that controls the degree of hydrolysis. The PVA product was characterized by IR spectroscopy and the melting point in comparing with an authentic sample.

PVA product was soluble in warm water and remained soluble on cooling. An aqueous solution of PVA product showed excellent adhesive properties.

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bromination reaction over  $-\text{OCH}_3$  substituted parent compound proceeded all the way to dibromination. It was also observed that the substitution of bromine to the phenyl ring involves an energy barrier much higher than that for the olefinic substitution. Accordingly no ring substituents were detected as products. Calculations for iodine could not be performed due to the unavailability of the basis set for iodine.

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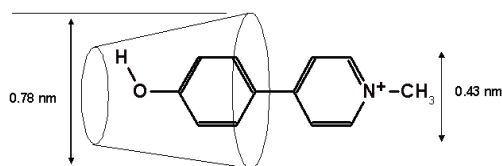
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613/E2

### Fluorescence Studies on Interaction of N-Methyl-4-(4'-hydroxyphenyl)pyridinium salt with Cyclodextrin

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Cyclodextrins (CDx) are cyclic oligosaccharides composed of glycopyranose unit linked together via oxygen bridges at the 1 and 4 positions ( $\alpha$ -(1, 4)-glycosidic bond). This class of organized media possesses a hydrophilic upper and lower rims lined with hydroxyl groups and a hydrophobic cavity linked ether oxygen. This structure gives CDx the ability to extract a variety of organic guest molecules of appropriate size.



Scheme 1: Structure of 4OHMPP<sup>+</sup> and inclusion complex formation between 4OHMPP<sup>+</sup> and CD

1-Methyl-4-(4'-hydroxyphenyl)pyridinium Iodide (4OHMPP<sup>+</sup>) is a good substrate for membrane bound amine transporters such as vesicular monoamine transporter (VMAT) and dopamine transporter (DAT). CDx can be used as an excellent model to study the mechanism of binding and transport of 4OHMPP<sup>+</sup> through the VMAT.

The inclusion of 4OHMPP<sup>+</sup> in Cyclodextrin (CDx) was studied by fluorescence and UV-visible spectroscopy at two different pH's (4.5 and 7.4) and three different temperatures (298, 303 and 308 K). In the polar protic medium, 4OHMPP<sup>+</sup> undergoes rapid deprotonation followed by formation of low fluorescence quinoid structure. Upon addition of CDs to 4OHMPP<sup>+</sup> in polar aqueous media, fluorescence enhancement was observed. This concludes that the guest molecule would interact with CDs hydrophobic cavity which prevents the deprotonation followed by quinoid structure formation. The binding constants were determined by fluorometric data shows 1:1 stoichiometry and which fixed in to the modified Benesi-Heldbrand equation,

$$\frac{1}{(F - F_0)} = \frac{1}{(F_\infty - F)} + \frac{1}{(F_\infty - F_0) \cdot K \cdot [\text{fluorophore}]}$$

where  $F$  and  $F_0$  are the fluorescence intensities in the presence and in absence of CD, respectively.  $F_\infty$  is the fluorescence intensity observed when all the 4OHMPP<sup>+</sup> molecules were complexes with CD.  $[\text{fluorophore}]$  is the concentration of 4OHMPP<sup>+</sup> and  $K$  is the binding constant. The binding constant increases with increasing temperature. The  $\Delta S^0$  accompany the complex formation is positive and it is entropically favored. This value is attributed to the loss of structured water around the guest molecule. Financial Assistance by NSF for research grant No RG/2005/FR/08 is acknowledged.

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614/E2

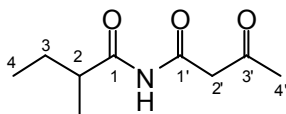
### Glaucamide A: A new fungal metabolite from a species of *Aspergillus glaucus* group

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Fungal metabolites are well recognized as an important source of a wide variety of drug leads used at present. From the world's first antibiotic, penicillin, to the potent anticancer agent wortmannin and the popular cholesterol lowering agent lovastatin, are all fungal derived secondary metabolites. Research aimed at discovering new potential drug leads from fungi is carried out globally but, is an area still poorly represented in Sri Lanka. As an outcome of a recent study initiated by us towards chemical and biological evaluation of soil and endophytic fungi collected from various parts in Sri Lanka, we report herein the isolation of a new fungal metabolite, glaucamide A (**1**). The fungus, isolated from a soil sample collected from the garden of the Botany Department at Sri Jayewardenepura University, and identified as a species of *Aspergillus glaucus* group using characteristic features of the colony and asexual reproductive structures, showed considerable antibacterial activity against an unidentified bacterial species during the isolation stage. The MeOH extract of the fungal culture grown on yeast malt agar (YMA), was concentrated and subjected to a series of solvent-solvent partitioning using EtOAc, hexane and CH<sub>2</sub>Cl<sub>2</sub>. The CH<sub>2</sub>Cl<sub>2</sub> fraction was purified by size exclusion chromatography followed by repeated silica gel chromatography to yield glaucamide A (**1**). The structure of **1** was established as 2-methyl-*N*-(3-oxobutanoyl)butanamide by HRESI(+)-MS data (*m/z* 208.0945 [M+Na]<sup>+</sup>, C<sub>9</sub>H<sub>15</sub>NO<sub>3</sub>Na requires 208.0944) and 1D and 2D NMR experiments (See Table 1).



(1)

**Table 1:** NMR Data (*d*<sub>6</sub> – DMSO, 600 MHz) of glaucamide A (**1**)

#	$\delta_H$ (multiplicity, <i>J</i> in Hz)	$\delta_C$	gCOSY	gHMBC
1		176.5		
2	2.46-2.48 (m)	41.4	H <sub>2</sub> -3, 2- Me	C-3, 2-Me, C-1
3	1.31-1.35 (m) and 1.50-1.55 (m)	26.1	H-2, H <sub>3</sub> -4	C-4, 2-Me, C-2
4	0.80 (t, 7.5)	11.2	H <sub>2</sub> -3	C-3, C-2
2-Me	1.00 (d, 7.2)	16.3	H-2	C-3, C-2, C-1
1'		169.0		
2'a & 2'b	3.76 (d, 16.5) and 3.83 (d, 16.5)	53.0		C-3', C-1'
3'		201.5		
4'	2.15 (s)	30.1		C-3', C-2'

<sup>13</sup>C assignments were made with the help of both gHSQC and gHMBC experiments

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615/E2

### Interaction of glyphosate with platinum electrodes

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Glyphosate [N-(phosphonomethyl)glycine] is a nonselective, post-emergence, broad spectrum herbicide. Its acute oral LD<sub>50</sub> value reported for rats is 5600 mg/kg. As glyphosate is commonly used, its reactivity toward different chemical species, and development of detection methods would be of important aspects of investigation. The study reported is on investigation of interaction of glyphosate and platinum (Pt) electrodes, and development of an amperometric method for the determination of glyphosate at Pt electrodes.

Cyclic voltammetric experiments of Pt electrodes in 0.1 mol dm<sup>-3</sup> NaCl with sequential additions of glyphosate indicate the appearance of many new peaks on both reduction and oxidation directions. The peak at -0.15 V vs. saturated calomel reference electrode (SCE) associated with the reduction of surface platinum oxide is initially enhanced, probably due to the high anodic starting potential. However, more sequential additions corresponding to an increase of 7.2 ppm glyphosate concentration per step result in a gradual decrease of this peak with concomitant appearance of a new peak at +0.25 V vs. SCE. Additionally, many new anodic and cathodic peaks are observed on the pure Pt surface, which is formed after the reduction of the surface oxide. These new peaks significantly alter the H-adsorption/desorption regions. The cyclic voltammetric scan, recorded with 140 ppm glyphosate concentration, indicates the appearance of an intense, concentration dependent redox couple centered at about -0.40 V vs. SCE. The log (peak current) vs. log (scan rate) plot for the reduction peak of this couple results in a linear relationship with a slope of about 0.50, suggesting that the mode of transfer of glyphosate molecules toward the electrode surface for electrochemical reaction is diffusion.

Steady-state amperometric experiments conducted at -0.45 V vs. SCE with sequential additions of glyphosate results in linear calibration curves with the sensitivity of  $1.50 \times 10^{-1} \mu\text{A mol}^{-1} \text{dm}^3$ , linear range (LR) of 14 ppm to 60 ppm, and the minimum detection limit (MDL) of 0.6 ppm.

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616/E2

### Arugambenol, a new acyclic diterpenoid from green alga *Ulva lactuca* L

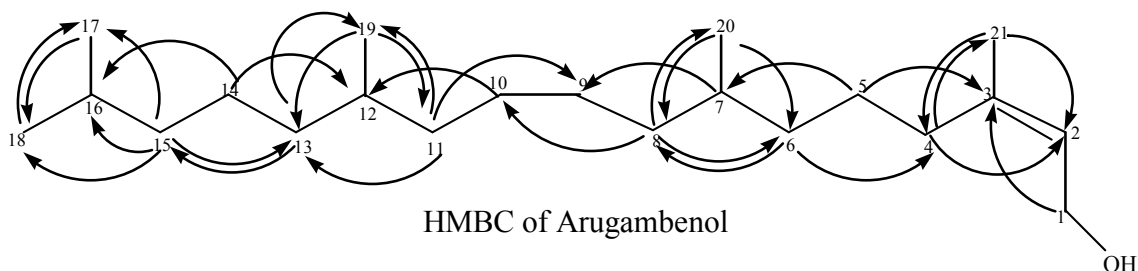
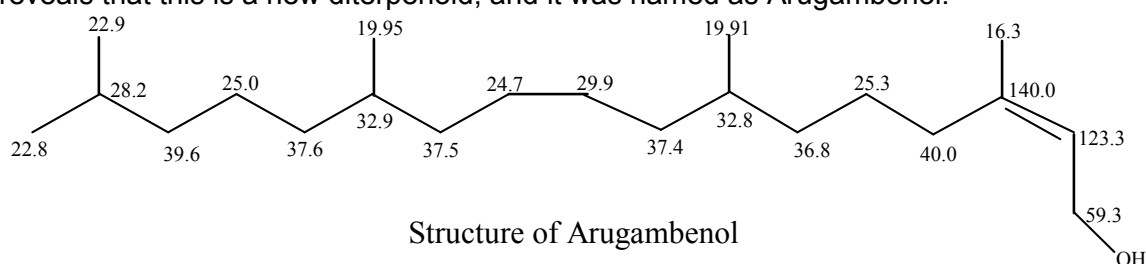
M H Haroon<sup>1,2</sup> and H R W Dharmaratne<sup>1\*</sup>

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As a continuation of our research work on Sri Lankan marine algae, methanol extract of the common seaweed *Ulva lactuca* was investigated. In our previous studies we reported the isolation of (Z)-stigmasta-5, 24(28)-dien-3-ol, oleic acid and a triglyceride with two linoleic acids and one stearic acid

unit. Further chromatography of the above MeOH extract gave a yellow coloured oil and its  $^{13}\text{C}$  NMR and DEPT data showed 21 carbon signals due to 5 methyl, 11 methylene, 4 methine and a quaternary carbon. All the proton-carbon correlations were assigned by a HMQC experimental data. Of the 21 carbons, two were ascribed as olefinic carbons appeared at  $\delta$  123.3 and 140.0, and 5 carbons resonated at  $\delta$  16.3, 19.91, 19.95, 22.8 and 22.9 were ascribed as methyl carbons. Moreover, the  $^1\text{H}$ NMR spectrum showed a doublet at  $\delta$  0.84 (6H,  $J = 6.4$ ) being a part of an isopropyl group that was coupled with a methine proton resonated at  $\delta$  1.48. Another doublet appeared at  $\delta$  0.82 ( $J = 6.0$ ) was assigned for the two parted methyl groups coupled to two methine protons appeared at  $\delta$  1.33. In the  $^{13}\text{C}$  NMR spectrum those two methyl carbons appeared at  $\delta$  19.91 and 19.95. Further, an allylic methyl, an olefinic proton and an oxy methylene group were observed resonating at  $\delta$  1.64 (3H, s), 5.40 (H, t,  $J = 6.4$ ) and 4.17 (2H, d,  $J = 6.8$ ) respectively. The CIMS of the compound exhibited its molecular ions at  $m/z$  309.0 ( $[\text{M}-\text{H}]^+$ ) and 311.0 ( $[\text{M}+\text{H}]^+$ ). The above data suggested this compound to be 3, 7, 12, 16-tetramethylheptadec-2-enol having the molecular formula  $\text{C}_{21}\text{H}_{42}\text{O}$ . Literature reveals that this is a new diterpenoid, and it was named as Arugambenol.



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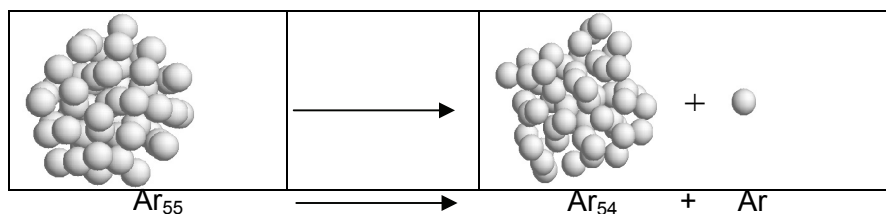
617/E2

### Unimolecular dissociation kinetics of rare gas clusters: A comparison of molecular simulation results with dissociation rate theories

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A molecular dynamics simulation was carried out to model unimolecular dissociation reaction of  $\text{Ar}_{54}$ ,  $\text{Ar}_{55}$  and  $\text{Ar}_{56}$  clusters. Mass spectra of  $\text{Ar}_n$  clusters indicate that  $\text{Ar}_{13}$ ,  $\text{Ar}_{55}$  like clusters are relatively stable compared to their neighbours. Those stable clusters which possess closed packed icosahedral structure are identified as “magic clusters” or “magic numbers”.



Dissociation rate constants,  $k(E)$  and distribution of the release of kinetic energy due to dissociation,  $P(E, \square_{tr})$ , as a function of internal energy,  $(E)$ , of the above mentioned three clusters were calculated. The dissociation rate constants, “computer experimental data”, were then compared with classical RRK theory for unimolecular dissociation. Simulation and theory rate constants show the same trend, that is  $k^{56}(E) > k^{54}(E) \gg k^{55}(E)$ , the lowest dissociation rate constant for the most stable cluster ( $Ar_{55}$ ). However qualitative agreement was very poor.

Further, least square fitting procedure was applied to fit simulation data to RRK theory expression by taking the two parameters, namely, frequency factor,  $\square$ , and degrees of freedom,  $(s-1)$ , as adjustable parameters. Obviously, the rate constants were in a good agreement (since the fitting procedure), and further the adjusted parameters indicate the higher dynamical stability of  $Ar_{55}$  clusters, in accord with the mass spectrum of  $Ar_n$  clusters.

Kinetic energy release distribution from molecular simulation gave a maximum at lower energy region with a long tail at higher energy region, while RRK theory showed exponential decay shape. However at higher kinetic energy releases both simulation and theory data showed a very good agreement. Instead of one frequency factor, one can use ratio of densities of state of product and the reactant as in RRKM theory. In this aspect, works are in progress to calculate classical density of states of rare gas clusters.

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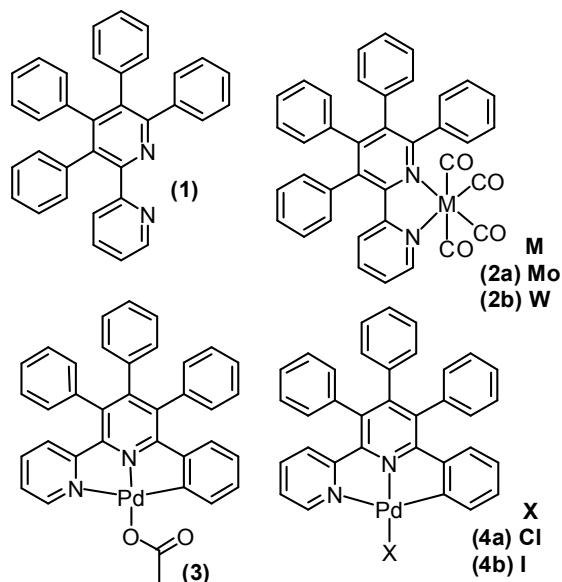
618/E2

### Metal complexes of 3,4,5,6-tetraphenyl-2,2'-bipyridine

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Recently our group reported the synthesis of polyphenylene compounds containing pyrimidyl groups. We are interested in pyridyl-centred polyphenylene compounds containing pyridyl groups as they can form metal complexes or coordination polymers depending on the number of pyridyl groups present in the molecule. Here we report the synthesis of 3,4,5,6-tetraphenyl-2,2'-bipyridine (**1**) (HL) and its complexes with Mo, W and Pd. The Ligand (**1**) was prepared by reacting tetraphenylcyclopentadienone with 2-cyanopyridine. The reaction of (**1**) with  $[Mo(CO)_4(piperidine)_2]$  gave the complex  $[Mo(CO)_4(HL)]$  (**2a**) in which the ligand (**1**) is bidentate. The analogous tungsten-complex (**2b**) was synthesised by treating (**1**) with  $[W(CO)_4(piperidine)_2]$ . Treatment of (**1**) with  $[Pd(OAc)_2]$  resulted in the formation of an *ortho*-metallated square-planar palladium(II) complex  $[Pd(OAc)(L)]$  (**3**) containing an anionic terdentate (NNC) ligand. Treatment of (**3**) with  $NH_4Cl$  gave the chloride-complex  $[PdCl(L)]$  (**4a**) which is insoluble in common organic solvents. Treatment of (**3**) with  $NaI$  afforded the slightly soluble iodide-complex  $[PdI(L)]$  (**4b**).



### Conclusion

The Ligand (1) was prepared and it has shown two coordination modes – (i) a bidentate ligand through both N-donors and (ii) an anionic (NNC) terdentate ligand.

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619/E2

### Purification of xylanase from *Bacillus* sp using Eudragit S-100

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The objective of the study is to compare the purification of xylanase produced by *Bacillus* sp with three phase partitioning and precipitation methods using Eudragit S 100 and to optimize these methods to increase the purification process. In the three phase partitioning method (Sharma *et al*, 2002) 14.6 U mL<sup>-1</sup> of xylanase activity was obtained with a specific activity of 31.4 U mg<sup>-1</sup>. The recovery of the enzyme was 52.2 % with 1.76 fold purification. In the precipitation method (Gupta *et al*, 1994), 15 U mL<sup>-1</sup> of xylanase activity was obtained with the specific activity of 33.42 U mg<sup>-1</sup>. The recovery of the enzyme was 52.2 % with 1.74 fold purification. Therefore the three phase partitioning and precipitation methods gave almost same results. To improve the purification, the conditions for purification by these methods were optimized. When the concentrations of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> was increased, at 50% saturation, highest specific activity (50.73 U mg<sup>-1</sup>) was precipitated. When different concentrations of Eudragit S-100 (10 to 150 g L<sup>-1</sup>) was used in the precipitating method, highest xylanase activity (18.92 U mL<sup>-1</sup>) was obtained with 40 g L<sup>-1</sup>. Highest Eudragit bound xylanase activity was eluted (17.82 U mL<sup>-1</sup>) with of 0.3M NaCl. When the three phase partitioning method was repeated with Eudragit 40 g L<sup>-1</sup>, 50% ammonium sulphate and the Eudragit bound xylanase was eluted with 0.3 M NaCl, 17.9 U mL<sup>-1</sup> of xylanase activity was obtained with a specific activity of 38.10 U mg<sup>-1</sup>. Xylanase enzyme yield was increased to 63.4 % and the purification fold was increased to 2.02. When the xylanase was purified by precipitation method with Eudragit 40 g L<sup>-1</sup> and the Eudragit bound enzyme was eluted with 0.3M NaCl, 19.0 U mL<sup>-1</sup> of xylanase activity with the specific activity of 43.19 U mg<sup>-1</sup> was obtained. Xylanase enzyme yield was increased to 69.7 % and the purification fold was increased

to 2.32. When the conditions were optimized among the two methods considered, the precipitation method was better than the three phase partitioning method for the purification of xylanase from *Bacillus* sp.

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**620/E2**

### **Extraction of plant growth factors from *Cocos nucifera* (coconut) water**

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Coconut is a versatile crop and it is of economic importance to Sri Lanka. The water in the mature fruit is not used for any important purpose in Sri Lanka. Coconut water is used as a tissue culture medium due to the presence of various growth factors. It contains lot of electrolytes, carbohydrates and amino acids and several plant growth hormones such as Auxins, Gibberellins occur naturally in coconut water. An Auxin called Indole Acetic Acid (IAA) is the most abundant plant hormone in coconut water. Extraction of plant hormones from fungal mycelia is well documented. By modification of the above methods, in the present study attempts have been made to isolate plant growth factor from coconut water. The growth factor was extracted from coconut water (2.0 L) using Ethyl acetate (10% v/v) and separated using preparative silica gel plates (20 × 05 cm, 0.5 mm Silica gel 60, Merck). The bands separated were scraped out and dissolved in absolute Ethanol (2.0 mL) and characterized using UV-visible spectrophotometer. The spectra were compared with those obtained for standard Indole acetic acid. Ten day old Bean hypocotyls were used to assay for the isolated hormone. Bean hypocotyls was immersed in varying concentration of the hormone extract (05, 10, 25 and 50 mg/L) and each treatment contained 5 replicates. The results were compared with those of Indole acetic acid treated samples. Percentage rooting, Number of roots and Total root length were measured after 14 days. All treatments showed considerable rooting after 14 days. Rooting in the hypocotyls treated with 5 mg/L of hormone extract recorded the highest root growth considering Number of roots and Total root length. It was significantly different from the other treatments. It can be conformed that hormones present in coconut water can be effectively extracted using the current method.

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**621/E2**

### **Antioxidant properties of virgin coconut oil and traditional Sri Lankan coconut oil**

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Higher polyphenol contents and better antioxidant properties have been reported for virgin coconut oil compared to copra oil prepared by pressing copra. However, the polyphenol contents and the antioxidant properties of virgin coconut oil (VCO) and traditional Sri Lankan coconut oil (TCO) prepared by boiling coconut milk, have not been compared. In the present study, the HPLC profiles of the phenolic fractions of TCO and VCO were compared and the antioxidant activities of VCO and TCO were also determined by DPPH radical scavenging assay.

The HPLC profiles of the phenolic fractions of VCO and TCO are given in Figure 1. The chromatograms indicate that TCO contains a more complex phenolic fraction. The total phenol contents of VCO and TCO calculated by the signal areas of the two chromatograms are  $33.5 \pm 0.2$  mg/ kg and  $547.4 \pm 63.5$  mg/ kg respectively. The DPPH radical scavenging activities of VCO and TCO are 18.5% and 79% (percentage inhibition) respectively.

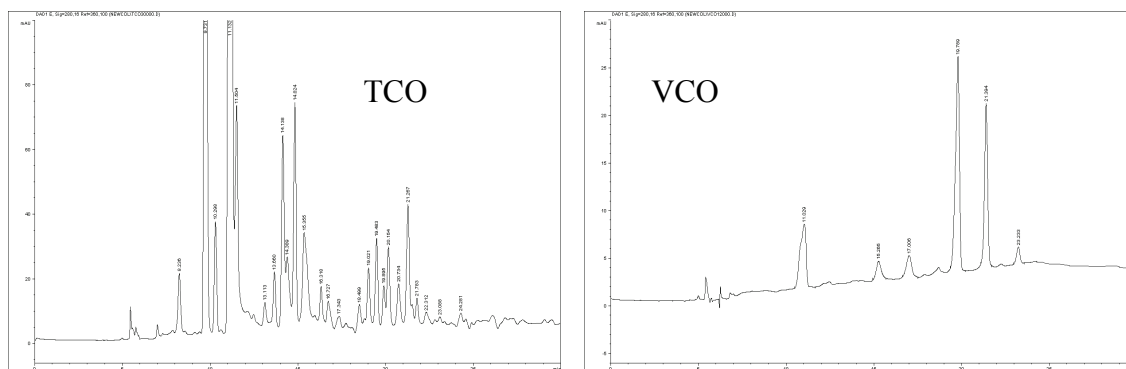


Fig 1. HPLC chromatograms of TCO and VCO

The results indicate that TCO is a richer source of antioxidants and TCO shows better antioxidant properties compared to VCO. Because of the high prices, Sri Lankan consumers are unable to consume VCO in their regular diet. However, due to the better antioxidant properties, TCO may render even better health benefits according to the above results.

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## 622/E2

### Study of the unfolding of bovine serum albumin induced by N-methyl phenyl pyridinium derivatives

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N-methyl-4-phenyl pyridinium salt ( $MPP^+$ ) and its methoxy derivatives (Scheme 1) act as an excellent substrate for vesicular monoamine transporter (VMAT) in dopaminergic neurons. It is important to study the interaction of these compounds with available protein models such as bovine serum albumin (BSA) to understand the mode of interaction of  $MPP^+$  with multiprotein complexes.



**Scheme 1:** The chemical structures of N-methyl-4-phenyl pyridinium salt (**1**,  $MPP^+$ ) and N-methyl-4-(4-methoxyphenyl) pyridinium salt (**2**,  $4OCH_3MPP^+$ )

The interaction of 4OCH<sub>3</sub>MPP<sup>+</sup> and BSA was studied in aqueous buffer solution at physiological pH (7.45) by fluorescence and UV-visible spectroscopy at three temperatures, 298K, 303K and 308 K and the binding mode, the binding constant and protein structure changes have been evaluated. The quenching constants  $K_q$ ,  $K_{sv}$  and the association constant  $K$  were calculated by using Stern-Volmer equation. The thermodynamic parameters, the enthalpy ( $\Delta H$ ) and the entropy change ( $\Delta S$ ) were obtained using van't Hoff equation and summarized in the Table 1. Quenching spectra of the BSA shows a red shift which indicates the changes of secondary structure of the protein upon binding of quencher.

Table 1: Thermodynamic and quenching parameters for quenching of BSA by 4OCH<sub>3</sub>MPP<sup>+</sup> at pH 7.45

Temperature (K)	$K_{sv}$ ( $\times 10^4$ L mol <sup>-1</sup> )	$K_q$ ( $\times 10^{12}$ L mol <sup>-1</sup> s <sup>-1</sup> )	Binding constant $K$ ( $\times 10^4$ M <sup>-1</sup> )	$\Delta G^0$ (kJ mol <sup>-1</sup> )	$\Delta H^0$ (kJ mol <sup>-1</sup> )	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	# of binding sites (n)
298	1.78	1.78	1.26	-23.11			0.97
303	1.67	1.67	2.12	-25.66	128.44	508.58	1.04
308	1.54	1.54	6.80	-28.19			1.15

The negative sign for  $\Delta G^0$  indicates that the binding process is spontaneous. For drug-protein interaction, positive entropy is frequently taken as the evidence for hydrophobic interaction, but it has been pointed out that positive entropy may also be a manifestation of electrostatic interaction. Furthermore, the main source of  $\Delta G^0$  value is derived from a large contribution of  $\Delta S^0$  term with no contribution from the  $\Delta H^0$  factor, so the main interaction is by hydrophobic contact, but the electrostatic interaction cannot be excluded.

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## 623/E2

### Fingerprinting market samples of *Pterocarpus santalinus* L. (Rat handun) and its adulterant

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*Pterocarpus santalinus* L. (Fabaceae) commonly known as Rat-handun (Sinhala), is a rare medicinal plant species found mainly in southern Sri Lanka. The objective of the present study is to diagnose key characters to differentiate *P.santalinus* from *Myroxylon balsamum*, which is its major adulterant, found in the local market and to give unique features to authenticate *P.santalinus*.

Twenty seven market samples collected from leading crude drug market in Colombo were used for the study. Heartwood samples of true *P. santalinus* and *M.balsamum* were obtained from trees growing in private gardens. Microscopic analysis and TLC analysis of wood samples and authentic specimens were done using standard methods

Microscopic features of wood scored as detailed structure and arrangement of vessels, vessel deposits, axial parenchyma and ray parenchyma of authentic *P.santalinus*, Indian Rath-hadun and

Indian Rathkiriya were identical and unique, while features observed in Lanka Rath-hadun and Rathkiriya were identical with those in *M.balsamum*.

Methanol extract of *P.santalinus*, *M.balsamum* and market samples were chromatographed on the silica gel plates using chloroform:methanol (20:1) as the solvent system. Separated compounds were visualized under normal light using Anisaldehyde/sulphuric acid reagent. A blue coloured spot at  $R_f$  (0.6) was observed in the chromatogram of *P. santalinus*, Indian Rath-hadun and Indian Rathkiriya, which was not found in the chromatogram of *M.balsamum*, Rathkiriya and Lanka Rath-hadun. This was identified as pterocarpol by Mass spectroscopy,  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectroscopy. Microscopic analysis and TLC analysis clearly showed that Indian Rath-hadun and Indian Rathkiriya are identical to *P.santalinus*, while Lanka Rath-hadun and Rathkiriya are identical to *M. balsamum*. This study indicates the possibility of using micro morphological features and TLC fingerprint to differentiate genuine *P. santalinus* from its adulterants in the crude drug market.

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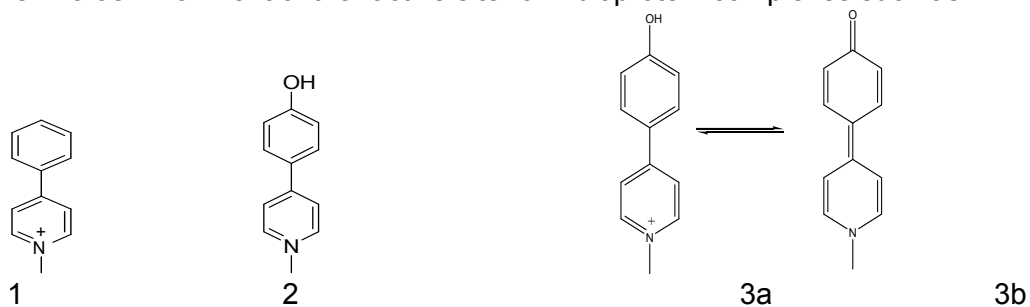
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624/E2

### Study of the interaction of neurotoxic N-Methyl-4-(4'-hydroxyphenyl) pyridinium iodide with bovine serum albumin

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N-Methyl phenyl pyridinium salt (MPP<sup>+</sup>) and its derivatives are known for its ability to bind to membrane bound protein complexes such as vesicular monoamine transporter (VMAT) and dopamine transporter (DAT) as well as enzymes such as cytochrome P<sub>450</sub> and monoamine oxidase (MAO) B. Among these derivatives, 1-Methyl-4-(4'-hydroxyphenyl)pyridinium Iodide (4OHMPP<sup>+</sup> Scheme 1) has remarkable polarity dependent excited state properties and can be used as an excellent model to study the microenvironment of the "active site" of multiprotein complexes such as VMAT .



**Scheme 1:** N-Methyl phenyl pyridinium salt (MPP<sup>+</sup>) and 1-Methyl-4-(4'-hydroxyphenyl)pyridinium Iodide (4OHMPP<sup>+</sup>). 3a and 3b are the structural variation of 2 at different pH values, 5.50 and 7.45 respectively.

In this work, bovine serum albumin (BSA) is selected as our model to understand the interaction of 4OHMPP<sup>+</sup> with protein because its wide range of physiological functions involving binding, transport and delivery of various biomolecules. The interaction of 4OHMPP<sup>+</sup> and BSA was studied in aqueous buffer solution at pHs (5.50, 7.45) by fluorescence and UV-visible spectroscopy at 298K, 303K and 308 K. The binding mode, the binding constant and protein structure changes have been evaluated. The quenching constants  $K_q$ ,  $K_{sv}$  and the association constant  $K$  were calculated by using Stern-Volmer equation based on the quenching of the fluorescence of BSA. It has been manifested that

both dynamic and static quenching occurs between the quencher and the fluorophore and quenching data fit into the modified Stern-Volmer equation.

$$K_{APP} = \left( \frac{I_0}{I} - 1 \right) \frac{1}{[Q]} = (K_{SV} + K_S) + K_{SV} K_S [Q]$$

The thermodynamic parameters, the enthalpy ( $\Delta H$ ) and the entropy change ( $\Delta S$ ) were estimated by using van't Hoff equation. Quenching spectra of the BSA shows a red shift which indicates the changes of secondary structure of the protein upon binding of quencher.

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**625/E2**

### **Oral glucose tolerance of some medicinally important plants on glucose induced hyperglycemic rats**

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Present investigation was initiated with the aim of identifying potential hypoglycemic plants for further studies. Initially freeze-dried water extracts of 5 medicinal plants (*Argyreia populifolia*, *Benincasa hispida*, *Morinda citrifolia*, *Languas galanga* and *Careya arborea*) were tested for their glucose tolerance using glucose induced hyperglycemic rats. Male Wistar rats (185±10g) were grouped into 7 (Group I-VII) each containing 6 rats and acclimatized them for laboratory conditions for 5 days and fasted for 18 hours before starting the experiment. Following doses given to each group. Group I: 2mL of distilled water (control), Group II: glibenclamide /oral dose of 10mg/Kg (positive control). Group III-VII: tested plant extracts oral dose of 300mg/Kg. After 30 minutes of dosing, rats of all groups were orally treated with 2g/Kg of glucose. Blood samples were collected from the tail vein just prior to glucose administration, at 30minutes and 90 minutes after glucose loading. Serum glucose levels were measured using a commercial diagnostic kit. Treatment data were compared with the control using one-way ANOVA and Tukey's comparison. At zero hours (after 30 minutes of extract administration) blood glucose level of Glibenclamide, *B. hispida* and *A. populifolia* were found to be not significantly different from the control. It was noted that while *L. galanga* extract has significantly ( $p < 0.001$ ) reduced the blood glucose level, extracts of *M. citrifolia* and *C. arborea* significantly ( $p < 0.001$ ) increased the blood glucose level. After 30 minutes of glucose loading, Glibenclamide and *L. galanga* significantly ( $p < 0.001$ ) reduced the blood glucose level. After 90 minutes of glucose loading, only Glibenclamide has significantly ( $p < 0.001$ ) reduced the blood glucose level. However, *L. galanga* has significantly ( $p < 0.001$ ) reduced the blood glucose level at 0 hours and at 30 minutes, and the maximum glucose tolerance for *L. galanga* was noted at 30 minutes after glucose loading. Therefore, *L. galanga* should be further tested for its potential hypoglycemic effect using a chemically induced diabetic animal model.

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626/E2

### Evaluation of rice grain quality in some Sri Lankan rice varieties

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Grain quality in rice is an important component determining domestic consumption, and local and international trade. Rice grain structure is heterogeneous; each grain contains specialized regions, that differs in character which affect grain characteristics such as hardness, nutrient content, vitamins, minerals, lipids, proteins, dietary fibre etc.

In Sri Lanka, valuable reserves of rice (*Oryza saiva L.*) germplasms are available at Regional Rice Research and Development Centre (RRRDC), Bombuwala for breeding to develop and improve new rice varieties with enhanced grain quality. The present study describes evaluation of some grain quality characters in 22 rice varieties obtained from Bombuwala during 2005/2006 maha season, for protein and lipids as main indices of chemical parameters and pericarp colour and grain size as physical parameters in order to evaluate germplasms for breeding programmes.

Rice samples were dehusked and the whole grain was used for the evaluation of physical parameters, while the whole grain milled to particle size 0.5 mm was used for the evaluation of chemical parameters. Established procedures were used for the determination of physiochemical characters; protein and fat by kjeldhal method (N x 5.95) and soxhlet extraction method respectively, while pericarp colour and grain size by visual observation and grain length to width ratio respectively.

Results indicated high protein levels of 12.1-11.0 % w/w on dry weight basis, present in Rathal, Bg 360, Bw 272-6b, Bw 361, Ld 356, Kalu Heenati, Sudu Heenati, Devaraddhari, Beath Heenati, Molligoda and, Kahata wee, where as the rest contained protein levels of 11.0-9.6 % w/w on dry weight basis. Fat contents present in varieties, vary in the range of 3.9 - 2.3 % w/w on dry weight basis. Pericarp colour is either red or white and further indicated that it does not depend on the nutrient content of the grain. Most of the grains are mainly intermediate or it's combinations in grain size while the rest is long grain and small grain. These results will aid the breeders to improve grain with proper combinations of nutrients and consumer acceptance.

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627/E2

### An investigation of the antioxidant activity of some selected traditional Sri Lankan medicinal oils

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Antioxidant properties of medicinal oils enhance the quality of oil-based beauty care products. In addition, such antioxidant properties are also responsible for several beneficial health effects and the oxidative stability of edible oils. In the present study, antioxidant properties of the phenolic extracts of the oils extracted from the seeds of *Calophyllum inophyllum* (Domba), *Madhuca nerifolia* (Mee), *Brassica juncea* (Aba), *Ricinus calamus* (Endaru), *Sessamum indicum* (Thala) and *Canarium*

*zeylanicum* (Kekuna) were evaluated by chemical methods. The DPPH radical scavenging activity (DPPH RSA), inhibition of the deoxiribose degradation (IDD), and the reducing power (RP) in potassium ferricyanide system were studied as parameters of antioxidant activity. The total phenol contents (TPC) of the oils were determined by Folin-Denis colorimetric method. The results are given in Table 1.

Table 1. Antioxidant activity and total phenol content of the phenolic extracts of medicinal oils

	Domba	Aba	Mee	Kekuna	Thala	Endaru
RP (%)	368 ± 2	247 ± 3	189 ± 3	161 ± 1	126 ± 1	54 ± 5
DPPH RSA(%)	80 ± 1	69 ± 1	67 ± 1	55 ± 1	25 ± 1	21 ± 1
IDD (%)	56 ± 1	47 ± 1	45 ± 1	42 ± 1	39 ± 1	31 ± 1
TPC (mg/ kg)	111 ± 5	107 ± 7	98 ± 8	66 ± 6	43 ± 8	31 ± 3

Each data point represents the mean of three replicates ± S.E

The results indicate that the phenolic antioxidants present in the extracts of above oils are effective as antioxidants and the antioxidant capacities of these oils are directly related to the total phenol contents of the oils.

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628/E2

### A comparative study of oil content and composition of Sri Lankan and Indian cultivars of vetiver (*Vetiveria zizanioides* L.)

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Vetiver (*Vetiveria zizanioides* L.), a scented grass with a lacework root system belongs to family Poaceae, is extensively used in perfumery industry. Chemical composition of vetiver essential oil (VO) extracted from the roots through hydro-distillation is extremely complex, containing more than 100 compounds that are mainly sesquiterpenes and their derivatives and the three constituents are khusimol,  $\alpha$ - vetivone and  $\beta$ - vetivone. The objective of the study was to find the most suitable treatment to obtain more oil and to find the effect of different geographical origin on the quality of vetiver oils.

Dried roots of Indian cultivar (IN) and Sri Lankan cultivar (SL) were taken. Both samples were subjected to different treatments; 1) samples cut into small pieces (control), 2) samples cut into pieces and crushed (t1) and 3) samples cut into small pieces and soaked in water for 3 days (t2). Oil was extracted by water distillation, percent oil content was calculated and essential oils were analyzed to identify constituents and their percent concentrations using Shimadzu GC 8A Gas Liquid Chromatograph equipped with FI detector and 10 % Carbowax column 20M WAW. The constituents of oil were identified using previous chromatographic studies on vetiver oil.

SL cultivar showed high VO content compared to IN cultivar in each treatment. There can be a loss of VO due to crushing of samples and therefore the volatile oil content of vetiver was less in treatment 2

and 3. The Control shows the highest oil content and it was 1.5 % in Sri Lankan cultivar. The Sri Lankan vetiver oil was golden yellowish in colour whereas Indian vetiver oil was yellowish in colour.

Table.1: Average percent concentrations of sesquiterpenes in vetiver oil

Variety	Average % concentration of sesquiterpens		
	Khusinol	$\alpha$ -vetivone	$\beta$ -vetivone
Sri Lankan cultivar	6.08	13.74	37.21
Indian cultivar	2.33	11.73	21.89

Sri Lankan cultivar contained higher concentrations of sesquiterpenes compared to Indian cultivar, may be due to geographical differences (Table. 1).

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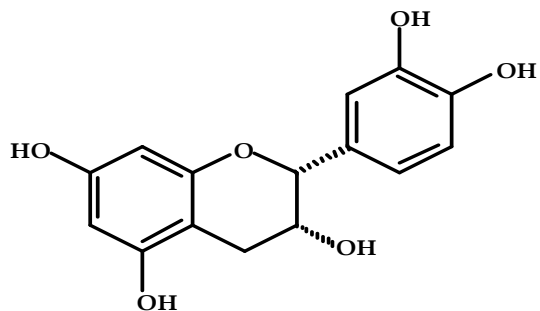
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**629/E2**

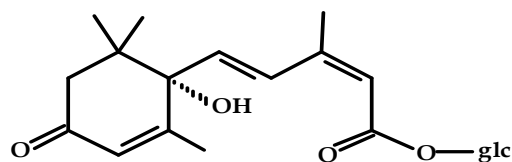
### **Chemical constituents of the fruit juice of *Averrhoa carambola***

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The *Averrhoa carambola* (star fruit) of the family Oxilidaceae is a slow growing, modarate size, shrub like ornamental tree in Sri Lanka. Its fruit starts out green and goes to yellow as it ripens, though it can be edible in both stages. The star fruit has an antidiabetic and high blood tension lowering effect, an appetite stimulator and an anti-diarrhea, anti-scurvy, antipyretic attributes. In a continuation of our studies on edible fruit of Sri Lanka, we chemically investigated the fruit juice of *A.carambola*. Fruit juice was partitioned with ethyl acetate/water and *n*-butanol/water respectively. Preliminary studies indicated the presence of antioxidant compounds in both EtOAc and *n*-butanol extracts by TLC bioautography method. Chromatographic separation of the combined EtOAc and *n*-butanol extracts over combination of chromatography over silica gel, sephadex LH-20, reverse phase silica gel and reverse phase HPLC furnished (-)-epicatechin (**1**) and abscisic acid  $\beta$ -D-glucopyranosyl ester (**2**). Only the compound **1** showed antioxidant properties towards the DPPH radical by spectrophotometric method.



1



2

glc =  $\beta$ -D-glucopyranosyl

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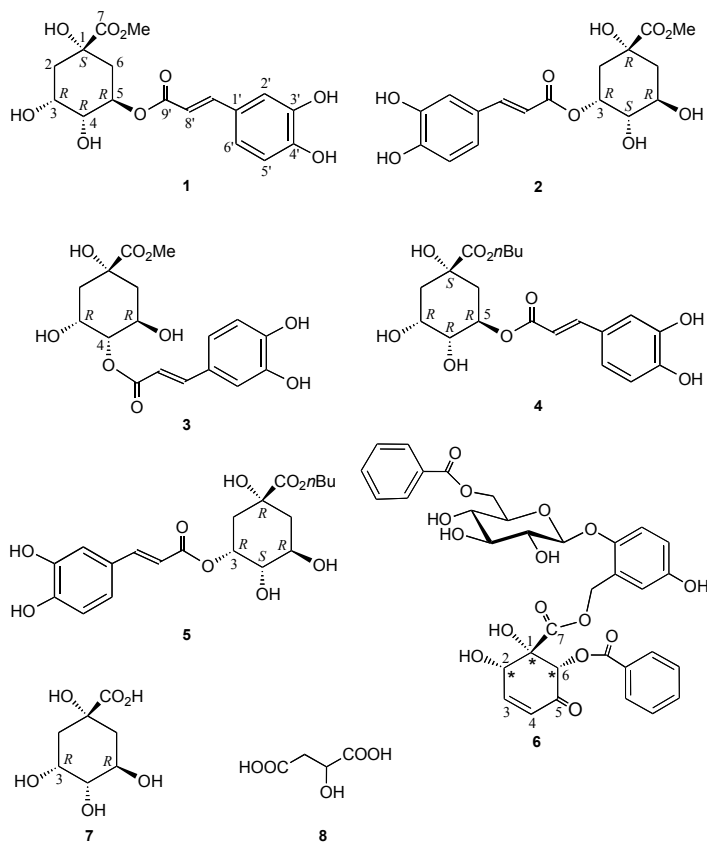
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630/E2

### Antioxidant phenolic constituents from the fruit juice of *Flacourtia inermis*

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In a continuation of our research work on search for biologically active compounds from Sri Lankan plants, present investigation is carried out on the fruits of *Flacourtia inermis* Roxb. of the family Flacourtiaceae. *F. inermis* is a moderate size tree growing in Sri Lanka. Its red colored fruits are edible and very popular in Sri Lanka. No previous chemical or biological investigations have been reported hitherto on this plant/fruits. Chemical investigation of the fruit juice of *Flacourtia inermis* furnished five chlorogenic acid esters methyl 5-O-caffeoylquinic acid (1), methyl 3-O-caffeoylquinic acid (2), methyl 4-O-caffeoylquinic acid (3), *n*-butyl 5-O-caffeoylquinic acid (4), *n*-butyl 3-O-caffeoylquinic acid (5), a rare phenolic glucoside (*rel*)-(6 $\beta$ -benzoyloxy-1 $\alpha$ ,2 $\alpha$ -dihydroxy-5-oxocyclohex-3-enecarboxylic acid 2-(6-O-benzoyl- $\beta$ -D-glucopyranosyloxy)-5-hydroxybenzyl ester (6), together with quinic acid (7) and malic acid (8). Compounds 1 - 6 showed strong radical scavenging properties towards the DPPH radical.



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631/E2

### Development of a spectrophotometric method to analyze the benzoic acid content in carbonated beverages

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Benzoic acid is one of the commonly used food preservatives and often used in carbonated beverages. Most of carbonate beverages contain approximately 150 mgL<sup>-1</sup> of benzoic acid. It has been found that excessive amount of benzoic acid can cause toxic effects on human. Therefore, it is essential to determine benzoic acid content in carbonated beverages before using for human consumption. High Performance Liquid Chromatography (HPLC) is used as a common analytical method to determine benzoic acid content in beverages. Use of HPLC based techniques to determine benzoic acid content in beverages is not economical to a developing country like Sri Lanka. In this article, we have reported the development of spectrophotometric based low cost method to analyze of benzoic acid content in carbonated beverages found in Sri Lanka.

Prior to the analysis, benzoic acid in beverages has to be separated from other chemical constituents present in the medium. Apart from food preservatives, various coloring agents also contain in beverages. Most of these chemicals are water soluble compounds. Separation of benzoic acid from other substances can be performed by extracting benzoic acid into the methylene chloride. After the

evaporation of methylene chloride, the remaining residue was dissolved in diluted NaOH, convert benzoic acid into its sodium salt. To remove the any non polar substances present with sodium benzoate, another extraction was carried out with methylene chloride. The remaining aqueous phase was acidified with HCl and extracted the benzoic acid in to methylene chloride medium.

After evaporating methylene chloride layer, the white solid of benzoic acid was obtained. The standard series was prepared by dissolving the benzoic acid in methanol with appropriate concentrations. The benzoic acid ( $\lambda_{\max} = 226 \text{ nm}$ ) content in beverages was measured using the calibration plot acquired from standard series.

By using the standard method obtained from literature, analysis of benzoic acid in carbonated beverages was also performed by HPLC method. Based on the result obtained, the benzoic acid content in all five carbonated beverages determined by spectrophotometrically and HPLC methods are in good agreement.

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## 632/E2

### **Modification of extraction methods of coconut oil to incorporate more phenolic substances**

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The amount of phenolic compounds in cooking oils is an important factor when the quality of the oil is evaluated. The phenolic composition of a seed oils is the result of complex interactions between several factors, including degree of maturation, extraction method and conditions during extraction. In the present study, total phenol contents and *o*-diphenol contents of the phenolic extracts of coconut oil were determined as a function of the standing time of coconut oil near the boiling temperature. During this study, coconut milk was prepared by hand pressing coconut kernel with water and water was evaporated from this mixture by boiling to prepare traditional coconut oil. When the water layer evaporated completely, the coconut oil was allowed to stand under boiling conditions and samples were collected for total phenol and *o*-diphenol analysis after every five minute interval.

The total phenol contents of coconut oil increased from  $34 \pm 4 \text{ mg/kg}$  to  $708 \pm 5 \text{ mg/kg}$  while *o*-diphenol contents increased from  $11 \pm 1 \text{ mg/kg}$  to  $94 \pm 1 \text{ mg/kg}$  within 30 minutes of heating. The phenol contents in coconut oil decreased upon standing further at boiling temperature due to the caramelization of oil followed by deposition of phenolic substances at the bottom of the container. The results indicate that the phenolic compounds are properly incorporated into coconut oil at high temperatures. Due to the presence of triglycerides of mainly saturated medium chain fatty acids, coconut oil is extremely thermally stable. Due to this thermal stability, high temperature conditions for about 30 minutes can be easily used for the enrichment of coconut oil with phenolic substances without affecting the composition of coconut oil.

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633/E2

**An assessment of copper content in BOPF grade Sri Lankan black teas  
(*Camellia sinensis* L.) of different agro-climatic elevations**

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Copper is an inorganic substance inherently and substantially available in black tea. In addition to the inherent copper it may also be added due to usage of copper fungicides in tea plantations. Copper content in black tea could vary with the soil characteristics in different agro-climatic elevations. Copper compounds in tea is hot water soluble and therefore, it is possible that appreciable amount of copper gets transferred to the Black Tea Brew (BTB). The amount of copper in BTB with respect of the agro-climatic elevations is not scientifically documented. Thus the aim of this study was to assess the copper content in black tea manufactured by orthodox-rotorvane process of three different elevations: low grown (below 600m, average mean sea level), mid grown (600-1200m, amsl) and high grown (above 1200, amsl) of Sri Lanka and in the tea brew using Atomic Absorption Spectrophotometer method.

The results show significantly higher ( $P \leq 0.05$ ) content of copper in black tea of mid grown teas ( $75.5 \pm 4.52$  ppm) compared to other two elevations: low grown ( $39.6 \pm 3.62$  ppm) and high grown ( $27.3 \pm 0.67$  ppm). When considering the copper content in BTB, it was found that an average of 60%, 93% and 66% of copper has been transferred from black tea to the BTB of low grown, mid grown and high grown respectively. The results show that the amount of hot water extractable copper in black teas of all three elevations: low, mid and high grown, varies elevation-dependant manner. Thus the consumption of Sri Lankan black tea of all three elevations may be a good dietary copper supplement for the human.

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634/E2

**Screening of traditional rice varieties of Sri Lanka for micro-nutrients; Iron, Zinc and Phosphorus**

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Iron deficiency anaemia is a major health problem in Sri Lanka. Nearly one third (31.2%) of pre-schoolers, 20.0 % of primary school children, 22.3 % of adolescents and 30.2 % of pregnant women are anaemic.

Dietary iron intake in developing countries consists primarily of non-heme type, where poor absorption is considered as a major factor in iron deficiency anaemia. Recent scientific research approaches on

bio-fortification of staples such as rice and maize have been successful as an effective vehicle to improve bio-availability of iron to the human body, in order to combat iron deficiency anaemia in the population. Although iron is available in rice, its bio-availability to the human body is low due to the presence of phytates, which is a potent inhibitor of iron absorption. It is reported that in 75 % of grain and legumes, the total phosphorus is found as phytic acid. Zinc plays a vital role in the functioning of enzymes, growth and development.

Germplasm screening has shown a large genetic variation in iron and zinc concentrations of raw rice. Some traditional varieties have reported double concentration of these elements. Therefore in an attempt to improve the bio-availability of iron in rice, *Oryza sativa L.*, the present study is focused on screening 27 rice cultivars, 24 traditional and 3 improved varieties obtained from Regional Rice Research and Development Centre (RRRDC), Bombuwala, Sri Lanka cultivated in iron rich soil during 2005 yala season for micronutrients; iron and zinc, and phosphorus content. Rough rice samples were air dried to about 12 % moisture content, dehusked manually and whole grain was used for the study.

Iron and phosphorus content were determined by UV spectrophotometric technique and zinc was determined by Atomic Absorption Spectroscopic method (AOAC, 2000).

Results indicated that there are no significant differences between iron levels in rice varieties ( $P=0.06$ ). Apparently high iron levels of 3.1-3.0 mg/100g are present in rice cultivars of Kattamanjal, Sudu Heenati and Bw-272-6b, moderate iron levels of 2.7-2.1 mg/100g are present in rice cultivars of 14 traditional varieties and in 1 improved variety while the rest have low levels of iron (2.0-1.7 mg/100g). Phosphorus and zinc contents varied in the range of 451 mg/100g to 262.2 mg/100g and 3.3 mg/100g to 2.1 mg/100 respectively.

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**635/E2**

### **Evaluation of protein quality in minor cereals grown in Sri Lanka**

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Kurakkan (*Eleusine coracana*), Meneri (*Panicum missiaceum*), Sorghum (*Sorghum vulgare*) and Thanahal (*Setaria italica*) are under utilized minor cereals in Sri Lanka. Studies on chemical composition indicated high protein contents for Kurakkan (Ravi), Meneri (AC254), Sorghum (ICSR 94002) and Thanahal (935), i.e. 7.7%, 12.8%, 7.8% and 13.8% (on dry matter basis) respectively. This study was undertaken in order to estimate the Protein Efficiency Ratio of the popular varieties of above cereals recommended to be grown in Sri Lanka by Field Crop Research Development Institute at Mahallupallama.

Determination of Protein Efficiency Ratio of minor cereals was carried out according to AOAC official method using a rat bio assay method with male Wistar rats. The average weight gain of rats were significantly lower than the reference diet ( $p \leq 0.05$ ) and the estimated Protein Efficiency Ratios of Kurakkan (Ravi), Meneri (AC 254), Sorghum (ICSR 94002) and Thanahal (935) were  $0.42 \pm 0.45$ ,  $0.28 \pm 0.29$ ,  $0.50 \pm 0.33$  and  $0.20 \pm 0.09$  respectively which are significantly lower than the reference casein ( $p \leq 0.05$ ). This confirmed low protein digestibility and bioavailability of the raw

cereals. It is expected that heat processing will increase the protein quality and this will be studied subsequently.

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**636/E2**

### **Formulation of a yoghurt enriched with vitamin A**

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Vitamin A deficiency is widespread in the early stage of life in developing countries due to number of causes that include limited dietary sources. The recommended safe level of daily intake of vitamin A for children of age 1-6 years is reported as 400 Retinol equivalent. Guidelines for eradication of vitamin A deficiency include fortification of commonly eaten foods with vitamin A preparations to those at risk. Fortification of yoghurt with vitamin A is one of the effective methods for overcoming such a situation due to its popularity as a low cost snack food. Hence, a study was carried out to introduce vitamin A fortified yoghurt with the assistance of manufacturing industry. Vitamin A content of yoghurt before and after fortification was determined by reverse phase HPLC at wavelength of 330 nm. Level of Vitamin A fortification that is 200 µg /100 mL was decided by adding different levels of Retinyl palmitate and studying the stability of vitamin A in fortified yoghurts on the day 1, 7 and 15 after fortification. Results revealed that vitamin A content of unfortified set yoghurt was  $29.2 \pm 5.04$  µg/100g and the addition of 200 µg of Retinyl palmitate per 100 ml gave a satisfactory recovery rate of  $186.1 \mu\text{g} \pm 3.25$  on the day 14 with a stability of 96.5%. Sensory evaluation was done with a 20-member panel (including both taste specialist and consumers) using five-point scheme and results showed that the fortified yoghurts scored an average of 21 point out of 25 indicating that Retinyl palmitate 200 µg /100 mL could be used successfully without changing the appearance, texture, smell or flavour of yoghurt.

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**637/E2**

### **Characterization of lauric oils**

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The major lauric oils that are commercially important are virgin coconut oil (VCO), king coconut oil (KCO), ordinary coconut oil (CNO), coconut paring oil (CPO) and palm kernel oil (PKO). Variation of oil composition and quality in different lauric oils provide important background information for their use in product development and processing. However, no comprehensive study has been reported on all of these oils. This study was undertaken to characterize the above mentioned oils with respect to their analytical parameters namely fatty acid composition, iodine value (IV), slip melting point (SMP),

free fatty acid (FFA) content, peroxide value (PV), moisture content (MC) and colour. VCO, KCO and CNO showed significantly higher ( $p < 0.05$ ) lauric acid contents than those of PKO and CPO. PKO showed the highest oleic acid ( $C_{18:1}$ ) content ( $14.97 \pm 3.18$  %) and it was the lowest for VCO ( $4.66 \pm 0.39$  %). Linoleic acid ( $C_{18:2}$ ) was significantly higher in KCO and VCO than those of other oils. A significant difference ( $p < 0.05$ ) in IV was observed for all the oils, while the highest was reported for PKO ( $15.856 \pm 0.184$ ) and the lowest was for VCO ( $6.422 \pm 0.707$ ). There was no significant difference ( $p < 0.05$ ) in MC and SMP of all five oils. The MC varied between  $0.12 \pm 0.03$  and  $0.16 \pm 0.05$  % while SMP varied from  $25 \pm 0.0$  to  $26.5 \pm 1.39$  °C for all the oils. VCO showed a significantly lower ( $p < 0.05$ ) colour when compared to that of PKO. As linoleic acid content is higher in both KCO & VCO than those of other oils, KCO & VCO are useful in nutritional aspects.

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## 638/E2

### A novel water-soluble carotenoid derivative from palmyrah (*Borassus flabellifer* L) fruit pulp

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Natural yellow water-soluble compounds are not available for use in the food industry. A possible solution can be based on these findings as for the first time, a water-soluble carotenoid is reported from a plant source, palmyrah fruit pulp (*Borassus flabellifer* L). The substance was extracted into acetone. On partition, a yellow colour was removed into the water layer and found out to be unextractable even into the 100% diethyl ether. The spectrum of the compound showed the characteristic three peaks of carotenoids. A freeze-dried water extract was reacted with naringinase at pH 4 (for rhamnosidase action) and 5.25 (for  $\beta$ -glucosidase action). Hydrolysis resulted in the release of glucose and rhamnose. As detected by thin layer chromatography (Tlc) rhamnose content was much smaller. Enzymic hydrolysis resulted in the ability to extract the product into petroleum ether. After hydrolysis parameters measured changed as follows;  $\lambda_{max}$  from 413, 443, 479 to 401, 426, 462;  $R_f$  on Tlc on 5% methanol in toluene from 0 to 0.89; retention time in high performance liquid chromatography (HPLC) (solvent system used was acetonitrile: methanol: tetrahydrofuran 58: 35: 7) from 4 to 28 min; response to epoxide tests (HCl vapor test and epoxy-furanoid rearrangement test) while the water-soluble carotenoid had no epoxy groups, after hydrolysis gave two epoxy groups which was compatible with the results of Tlc and HPLC data. The product was in *trans* configuration. Theoretically the parent carotenoid is likely to have had two hydroxy groups for the glycosylation, which during deglycosylation resulted in the formation of two epoxy groups. This is probably due to mechanism of glycosidic enzymic hydrolysis which proceeds through charged centers favoured the formation of epoxides. Palmyrah is a distinctive fruit as it contains substances for the glycosylation i.e.: substrates; glucose and rhamnose as well as enzymes; glycosyl and rhamnosyl transferases, which normally act on  $\beta$ -sitosterol to form glycosides. It is hypothesized as palmyrah fruit contains several underivatized carotenoids, one of which acts as a substrate analog of  $\beta$ -sitosterol. The water-soluble derivative or synthetic analogs could have commercial implications in the food industry as a food colourant.

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## SECTION F

### 701/F

#### **An empirical Investigation on factors affecting the performance of food system for processed fruits and vegetables in Sri Lanka**

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Consumer perceptions towards a number of factors, including: (1) level of food safety; (2) convenience to buy; (3) taste; (4) ethical issues; (5) cost of transaction; (6) origin of product; (7) available choices; (8) level of health & nutrition, and (9) behavior of firms have a greater impact on the effective performance of a food system of a country. This study examined this particular issue empirically using the data from processed fruit and vegetable product industry in Sri Lanka. An index – “*Consumer Welfare Index*” (CWI) was developed for this purpose, which is a product of two other indices: (a) *Consumer Importance Index* (CIM) to illustrate extent to which consumers judge the “relative importance” of each factor on their decisions to purchase a generic food item from the market, and (b) *System Performance Index* (SPI) to reflect the degree to which consumers perceived on the performance of this particular food system (i.e. processed fruit & vegetables sector) with regard to each of these 9 factors. The primary data collected from 500 consumers who belong to individual households in the *Wennappuwa* electorate (North Western Province) from June to August 2006 were used. With the idea of minimizing the empirical problems associated with unobservability of the true impact of each factor and subjectivity of which to the decision maker, the Confirmatory Factor Analysis techniques (CFA), including “Scale Reliability” (Cronbach Alpha), “Unidimensionality” (Principle Axis Factoring), and “Construct Validity” (Multi-Trait Multi Method Matrix) were employed to estimate the indices. The results suggest that, for the entire sample, the factors such as “food safety”, “health and nutrition”, and “origin of the product” has, in general, the highest impact in this respect. In opposite, the “behavior of firms” and “convenience to buy” possesses the least impact. Interestingly, the relative effect of individual factors did not vary significantly with respect to consumer demographic characteristics such as gender, place of living, level of education and income. The results suggest that food producers/marketers can “differentiate” their products/markets to retain a better share from consumers representing different demographic characteristics by performing satisfactorily on the factors that they placed a high preference

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### 702/F

#### **Evaluation of interventions of granary area program: A case study of Minneriya major irrigation scheme**

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Rice is the staple food of Sri Lankans. To meet the food requirement of the country, the government of Sri Lanka, in 2002 decided that overall paddy production level should be increased to 5 mt /ha within three years. In order to meet this target yield level, 6.5 mt/ha should be reached in the high potential major irrigation areas. Granary Area Programme (GAP) was introduced in 2003 to fulfill this

requirement through improving the productivity of rice in selected high potential irrigation schemes. Agricultural, irrigation and institutional interventions are the main component of the GAP. Objectives of this study were to document the impact of rice productivity improvement programme including GAP, to assess the impact of interventions of the GAP and identify the issues that will strengthen the implementation of GAP.

*Rajaela, Yodaela, Divlankadawala, Hathamuna, Wiharagama, and Buddiyaya* area of *Minneriya* scheme in *Polonnaruwa* district were selected for the field investigation. Data were collected from randomly selected 70 GAP farmers and 30 non-GAP farmers using structured questionnaire. With regard to components and activities of GAP, Percentage of GAP farmers using high quality seed paddy is 81 percent where as 70 percent of the non-GAP farmers use high quality seed paddy. Percentage of farmers using organic fertilizer in GAP area was 81percent while it was 70 percent in non-GAP area. GAP farmer percentage practice IPM is 32 percent and in contrast non-GAP farmer percentage is 20 percent. GAP farmers used high quality seed paddy, organic fertilizer and IPM practices to control pest than non-GAP farmers. About 43 percent of the GAP farmers and 23 percent of non-GAP farmers used mould board plough or disk plough for ploughing. In harvesting operations 21percent GAP farmers and 10 percent non-GAP farmers used machinery. In threshing 61 percent GAP farmers and 60 percent non-GAP farmers used combined threshers. There is an overall improvement in mechanization of all aspects in paddy cultivation. Within GAP area percentage of farmers who have agreed on Forward Sales Contracts (FSC) is 10 percent. However the buyers have not bought any paddy at the end of the season. This showed that FSC programme is not successful in this area. In order to reveal the yield performance, the Farmer Performance Index (FPI) was employed. It demonstrated that 60 percent of farmers in GAP area and 33 percent farmers in non GAP area have reached more than 100 percent FPI. Around 10 percent of the farmers in GAP area have obtained a paddy yield of more than 6mt/ha while 50 percent-obtained 5-6 mt/ ha. Comparatively, in non-GAP area none of the farmers could obtain 6mt/ha .In fact 67 percent of the farmers obtained less than 5mt/ha. The yields obtained by GAP and non-GAP farmers were compared employing t test of statistics. As the calculated value is 0.0224 (less than 0.05), There is a significant yield improvement in GAP area. It can be stated that overall impact of interventions under GAP is significant.

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**703/F**

### **Status of pesticide usage in Southern coastal belt in Sri Lanka**

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Pesticides usage in agricultural crops has increased tremendously in recent years in many parts of Sri Lanka. This has coincided with a significant increase in the recorded numbers of patients with diseases related to soil and water pollution. Lack of knowledge on the fate and behaviour of pesticides in Sri Lankan environment has contributed to such public perceptions.

*Matara* district has high agriculture potential areas. Both short term and long-term crops are cultivated which consumes pesticides and fertilizers heavily in the district. Farmers in this area are used to apply high amounts than recommended agrochemicals. This study was carried out to understand the

farmer's knowledge on crop types, pesticide circulation and pesticide handling in selected areas in *Matara* district.

Fifty farmers were selected randomly from seven *Grama Sewa* divisions in *Denipitiya* and *Dickwella* areas. They were interviewed using a prepared questionnaire.

Rice is the most common crop in *Dickwella*, where as Brinjal was the most abundantly growing crop in *Denipitiya*. In addition Pumpkins, Bitterguard, Okra, Snake Guard, Curry chilies, Raddish and Mukunuwenna are heavily cultivated in *Denipitiya* area.

Chloropyrifos (insecticide) (46.67%), propineb (fungicide) (33.33%) and carbofuran (insecticide) (13.34%) were the most commonly used pesticides by the farmers in *Denipitiya* area. Bispyribac sodium (76.19%) and thibencarb propynyl (76.19%) were the highly consumed weedicides ,fenobucarb (33.34%), fipronil (23.80%) and carbofuran (19.04%) were the intensively used insecticides in *Dickwella* area.

When the total usage of agrichemicals are concerned, high consumption of insecticides and fungicides were found in *Denipitiya* area where vegetable cultivation is prominent. The usage of weedicides is considerably high accompanying with insecticides in *Dickwella* area where rice is grown.

Farmers in *Denipitiya* use shallow wells or tube wells and in *Dickwella*, canal irrigation system, which originated from Rathmalae reservoir, is used for cultivations.

In both areas the knowledge of farmers on pesticides is very weak and also they use poor handling techniques. Hence they use overdoses and this may lead to contaminate soil and surface and groundwater to a considerable extent in both areas.

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**704/F**

### **Emerging trends in value chain of fresh fruit and vegetable marketing system in Sri Lanka**

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A Major development that occurred in the vegetable and fruit marketing system in Sri Lanka during the last ten years is the emergence of supermarkets. This transformation began in early 1990s, with the establishment of a few supermarkets in urban areas (e.g. Colombo). Since then, the change has created a major difference in the retail marketing of these commodities and within a period of about 12 years, it has grown to a large network with 91 supermarkets operated by six major companies. In 2004, the total volume of vegetables handled by six major supermarkets in Colombo was estimated to be about 60,000 kg/day. Major objective of the study was to examine the value chain changes in the vegetable and fruit marketing system in Sri Lanka with a view to identify the major changes that have occurred at retailer level in the more recent years. This study was based on primary and secondary data (May – June 2004). Primary data were collected by direct observation of supermarkets and

commercial fruits and vegetable shops, from supermarket management and informal discussions with employees and consumers. Secondary data were obtained from government and non-government organizations.

The supermarkets have developed close direct links with the producers, bypassing some 'middlemen', enabling the negotiation of prices to mutual advantage. The sale of vegetables and fruits through the system of supermarkets has facilitated the process of value addition through better grading, sorting, processing, improved packaging and transport. The rapid rise in the supermarket is caused by a number of factors including sharp increase in the urban population, market liberalization, improved income levels, changes in the urban life styles and food consumption patterns, and increased information flows. The growth in consumer demand for supermarket style trading service has provided a highly competitive environment for the supermarket operators as well. This competition in turn has led to improve customer service standards, better accountability, and more transparent and effective pricing mechanisms within the domestic agricultural marketing system. Increasing demand creates a pull at the retail end of the value chain and it signals towards the producer to send the products according to consumer preference. This is effective as it functions on the demand driven rather than on supply driven market mechanism. The trend of rapid spread of supermarkets and chain outlets assures a stable market for the producer, too. Due to the scale of high volume of vegetables and fruits, and increasing systemic efficiency, the supermarkets are able to provide the consumers with lower price products. Improved packaging, better quality, and value added products benefit the consumer.

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**705/F**

### **Role of seasoning mixtures in the process of tempering Kitul (*Caryota urens*) inflorescence**

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Kitul sap is used for making treacle, jaggery, toddy and vinegar. The sap is obtained by seasoning inflorescence (flower) in immature stage. Use of seasoning mixtures is the predominantly employed method of seasoning a flower. The objective of the study was to identify different seasoning mixtures used and their role in the process of tempering (seasoning) a Kitul flower. A questionnaire survey was conducted in 12 Kitul growing districts (*Kandy, Matale, Badulla, Matara, Nuwara Eliya, Kurunegala, Ratnapura, Galle, Kegalle, Moneragala, Hambantota and Kalutara*) to collect data. A multi-stage stratified sampling scheme was adopted for sampling.

Flowers of some Kitul trees were easy to season. The natural mixtures such as black pepper-based and spice-based were used for seasoning of flowers in this type of trees. There were some Kitul trees their flowers were difficult to season with natural seasoning mixtures. Tappers tended to use strong and artificial mixtures for inducing sap flow of such difficult trees. Ash-based and slaked-lime mixtures were widely used for this purpose. Seasoning of flowers during rains is difficult since they cannot be exposed to the influence of sun. This problem has been overcome by using strong seasoning mixtures including ash-based and slaked-lime. Incorporation of strong herbal ingredients like *kunumella* (*Schleichera oleosa*), *ratnitoli* (*Plumbago indica* L.), *ruk-attana* (*Alstonia scholaris*) and *japala* (*Croton siglium*) in the seasoning mixtures. Such effects have given successful results during rains. Bee honey and slaked-lime, and bee honey and ash were two mixtures used for generating heat during rains as a substitute for warmth of sun which is necessary for successful seasoning a flower. Rubbing with a cut lime fruit and a leaf bundle of species such as *kududaula* (*Neolitsea cassia*

L.), *ankenda* (*Achronychia laurifolia*) and *kenhanda* (*Clerodendrum serratum*) was helped to get rid of sticky substances from the cut surface in the early stage of tapping. Once a seasoning mixture was deposited in the flower peduncle, it may be subjected to attack of monkeys and rats. Therefore, sealing of the seasoning mixture is advisable. Application of a cement paste and ash of a coconut husk has fulfilled this task. When a Kitul flower is seasoned, the growing seeds should be removed in order to prevent maturing of flower and also to prevent drawing of sap to the seeds. Washing the flower with water extract of garcena (*goraka*) or a solution of slaked-lime helped to shed growing seeds without bruises.

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**706/F**

### **The incidence of poverty trap in the rural sector: An investigation into the persistence of poverty**

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There has been a long drawn debate on the extent and causes of chronic poverty in Sri Lanka. This debate was significant because poverty in the rural sector in particular appeared to persist despite the precipitous reduction of urban poverty. According to the most recent data the head count poverty of the rural sector hovers around a staggering 25 percent. This paper argues that the incidence of poverty trap at household levels is one of the fundamental causes that engender rural poverty. The concept of poverty trap illustrates how poverty process functions in a circular causation with a number of feedback loops. The objective of this paper is to explain why poverty persists in the Sri Lanka's countryside.

The paper employs the poverty trap framework to explain the incidence of poverty for which secondary data drawn from the CFSES of the Central bank of Sri Lanka and HIES of the Department of the Census and Statistics are used extensively. These two data sets are supplemented with primary data collected by the researchers in the district of Hambantota.

The findings of this study show that in the case of the lowest income deciles, in particular the poor face severe family budget constraints to meet their basic needs. The average 'dissavings' of the poorest income decile is about 2.5 percent. Consequently they are unable to meet the cost of food, health, education etc. The shortage of food grain causes malnutrition that makes them exposed to epidemics such as malaria, diarrhoea, and tuberculosis etc. This is especially so during droughts and associated conditions of famine. The situation is further compounded by the frequent incidence of unattended morbidity. Consequently, they are unable to reap the full potential of their farm plots. Their poor health restricts employment opportunities in the non farm sector. This diminishes their income flows altogether. Another channel of the poverty trap is the incidence of low educational attainment. The household heads who are illiterate are afflicted by low and irregular income flows. Moreover, they seemed to have failed to appreciate the importance of education needs of their own children as school attendance becomes poor in the poverty stricken areas; this becomes disturbingly low during the peak seasons when the child labour is abundantly used to meet increasing labour needs.

On the whole this paper argues that the conditions and processes as they operate today make the poor malnourished, weak in health status, exposed to further health hazards, afflicted by irregular and

unsteady flows of income thus making them incapable of moving out of the poverty trap. This process engenders persistence of poverty in the rural sector of the country.

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### **Bridging the social space between the Sinhala man and Tamil man: The role of social identity**

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Sri Lanka has been experiencing the brutality of the war, identified as "ethnic conflict" or "terrorism" by various concerned parties, for more than twenty-five years. This conflict is reflected even in the relationship of Sinhalese with the Tamils in the plantations. Why do people resort to terrorism or develop suspicions of each other? Among the many possible causes for this situation, are the existing identity differences between the ethnic groups which play a vital role. One group is trying to exercise power over the other claiming more rights based on heritage. Plantation workers make up a significant proportion of the country's population as a whole as well as of the Tamil community as a segment of the broader Sri Lankan society. There is a residential population of approximately 850,000, comprising over 240,000 resident families in the estates (Malwatte 2000: 404).

Colonial administrators got down the poor south Indian families here, for their cultivations as locals did not consent to work in their plantations as wage labourers, and settled them down in old barrack type "line houses", in the centre of the hill estates isolating them from the major Sinhala communities. Since then they have been working in the estates without much interaction with the Sinhalese. Through 150 years of life and labour on the plantations, the identity of the estate Tamil community has come to be defined by and large as "outsiders" (Philips 2001: 217). But this separation has been addressed by the post-independence governments to some extent through various development projects such as housing.

Against this backdrop a study was conducted from September 2002 to December 2003, in two housing schemes given to Tamils in Nuwara Eliya (Ganga Nagar) and Kaluataru (Jana Udana Gammanaya) with a view to understanding how changing dwelling pattern would affect the social identity and its influence on bridging the gap between Sinhala world and Tamil world. The study shows that the people who moved to separate houses; "*Gammane men*", "*Colony men*", do not belong to the similar low status identity groups similar to "*line room dwellers*". This has facilitated them to integrate with outside world in general and with Sinhalese in particular. It is not just the change in structure of the house but it is a change of entire lifestyle. The findings of the study shows that the social space between the Sinhalese and Tamils have been reduced by the housing interventions. And this has happened through the changes that took place in their aspirations, lifestyles, and integrations. The Sinhalese has shown their acceptance and readiness to recognize settlement Tamils as equals.

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### Evaluation of “Samurdhi” coconut cultivation development programme-2005

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Through the Samurdhi Coconut Cultivation Development Programme (SCCDP), 100,000 seedlings were distributed among 28,030 Samurdhi beneficiaries in 2005. To find out the effectiveness of this programme, a survey of beneficiary households was conducted in three regional management areas representing Gampaha, Anuradhapura and Moneragala.

The objectives of this study were to evaluate the effectiveness of SCCDP and to propose the improvements required for SCCDP. An average respondent in the Gampaha region spends 2% of his weekly food expenditure on coconut whereas in Anuradhapura and Moneragala it is around 3% and 9%. The SCCDP programme aimed at overcoming this expenditure. The results revealed that the target group selection is at a satisfactory level regardless of the region. Only 3% in Gampaha and 1% in Moneragala were reported as incorrect selections. The majority had an interest in coconut home gardening as they look for technology, seedlings and fertilizer subsidies. Fertilizer distribution among Samurdhi beneficiaries is inefficient in Gampaha due to poor packing material and handling. The technology dissemination process has not functioned well. In the Gampaha region around 34% of the respondents did not receive advice whereas in Anuradhapura and Moneragala it was 17% and 8% respectively. As there is a clear difference between advice receivers and non-receivers when practicing each activity in planting a seedling, technology dissemination process needs to be revised. Of the seedlings distributed, 89% had survived in Gampaha, 81% in Anuradhapura and 84% in Moneragala. In Anuradhapura and Moneragala, pest and diseases were the major death factor that contributed to 33% and 45% of the loss. The major cause in Gampaha was cattle damage which contributed to a 30% of the lost seedlings. Drought was a cause of death of 29% of the seedlings in Moneragala and 27% in Anuradhapura. Fertilizer application is poor in all the regions. In Gampaha region 43% do not apply fertilizer and in Anuradhapura and Moneragala it was 72% and 66% respectively. The use of kitchen waste and ash as a fertilizer source is popular among 41% of the respondents in Gampaha region and 20% and 33% in Anuradhapura and Moneragala regions respectively. It could be popularized as a source of fertilizer which can reduce the costs. The present management level of the seedlings is at a satisfactory level and it can be concluded that this programme is a successful strategy to expand coconut cultivation.

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### A comprehension of effects of inter-parental violence on children

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Domestic violence includes multiple forms of abusive behavior that takes place within the confines of the domain of “home” such as wife abuse, abuse of children, adults and women in general. Child abuse within family is the most prevalent form of domestic violence according to Giddens (2001). This study focuses on the impact of violence on children in the case of inter-parental violence which may or may not be directed towards the children who are generally exposed to such violence. The issue of effects of violence on the children who are exposed to inter-parental violence has been unfortunately

overlooked according to recent research studies (Blanchard 1993; Mullender *et al*, 2000; Laing 2000). The disregard towards the effects of inter-parental violence on children has led to numerous social issues and problems associated with personality disorders and difficulties associated especially in dealing with difficult and terrifying situations confronted in day to day life. (Laing 2000).

Evidence demonstrates that the incidence of domestic violence is quite high in Sri Lanka (Bulumulle, 2003). According to a UNICEF report most of the violations of the protection of rights of children occur in homes by close family members and the root cause includes marital discord and separations, domestic violence, migrant and therefore absentee mothers etc. (Wijemanna, 2005)

The objective of the current study is to understand the effects of exposure to violence between parents among children in a purposive sample of urban households afflicted with wife abuse through a qualitative research study.

Findings revealed that 88.5% households had children in them and at least 2 or more children in 73% of them. The children are very much equal victims of violence that was perpetrated against their mothers in the sample. Parents, particularly fathers more often manifest their anger against the children by way of scolding or disturbing the peace and quiet in the home by disturbing children's studies. Nearly 38% of children's education had been affected in terms of having never been to school, having dropped out of education without completing and failing grades in schools. Also exposure of children to violence between parents handicapped their personality development and growth, created health issues and resulted in deviant behavior in children. Men's tendency to emulate behavior witnessed and internalized automatically as a child was another very significant finding of this study. In conclusion, the damage to children who are exposed to inter-parental violence is profound particularly during the tender years. Immediate attention should be paid to make adults, parents and relevant authorities aware in bringing its negative outcomes into light and planning to eliminate such unwholesome consequences.

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**710/F**

### **Sri Lanka's fertilizer subsidy programme in paddy: Its operational and economic consequences**

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Fertilizer has become an indispensable input in paddy production. Nearly 55 percent of total fertilizer need in Sri Lanka is used for paddy cultivation. Current fertilizer application level (353,000 Mt) is the highest in 30 years in paddy sector. Sri Lankan government has spent Rs.6 billions in year 2005 and Rs.12 billions in year 2006 for fertilizer subsidy programme for paddy. This programme is the major policy instrument of the government to reduce farmer input cost and also to promote fertilizer use according to the recommendation. In year 2005, subsidy as 80 percent for urea, 78 percent for Muriate of Potash and, 77 percent for Triple Super Phosphate, which is the highest level of subsidy for fertilizer in the history.

The study investigated the past trends of fertilizer use in Sri Lanka and currently operating fertilizer subsidy programme facing on problems and issues. Further, study specifically aimed at analyzing the economic efficiency and feasibility of fertilizer subsidy programme at macro level.

Cost of cultivation is the major problem of domestic paddy cultivation and fertilizer amounted to around 17 percent of the total cost. Fertilizer subsidy has reduced 13.6 percent from total cost, which consoles the paddy farmer. Market price analysis of paddy and urea showed a change of price ratio from 1:1.2 (1995) to 1:0.7 (2005) which is favorable for the farmer.

Though urea consumption in paddy sector has increased from 157,600Mt in 1995 up to 266,200Mt in 2005 (69 percent increase), our national paddy production had increased from 2,810,000Mt in 1995 up to 3,246,000Mt in 2005 (only 16 percent increase).

The experimental data analyzed on paddy nitrogen response for *Batalagoda* area indicate that 117 kg/ha is the amount of nitrogen that can be added to produce maximum yield for the area; over that level will be uneconomical (current level was 105 kg/ha). Most probably in *Polonnaruwa*, *Ampara* and *Anuradapura* districts, paddy farmers may already be in the uneconomic zone due to over application of fertilizer. The national level data reveal that high nitrogen application has caused imbalance of fertilizer use at farm level. From 1980's N: P: K ratio for paddy was 4:1:1 and after introducing fertilizer subsidy program in year 1997, this has increased up to 6:1:1.

Unplanned and ad-hoc nature of the fertilizer subsidy programme has made a limitation to the success as expected. Fertilizer-importing companies had obtained nearly 28 percent of the subsidy as their overheads and administration costs unnoticeably, which made the government to bare unintended costs.

Overall, study ascertains that targeting the subsidy programme should be done precisely to make sure only deserving farmers would receive the subsidy. Fertilizer recommendations should be formulated based on economic analysis but not only on physical analysis.

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**711/F**

### **An analysis of some aspects of rice market mechanism based in Polonnaruwa**

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Rice marketing involves all the activities in the flow of paddy and rice moving from the producer to consumer. Almost 95 percent of rice marketing is handled by the private sector while around 5 percent is handled by the government sector (Central Bank, 2005). Paddy Collectors, Paddy millers and rice wholesalers are clustered under the concept of "middlemen". Therefore study in the activities of middlemen will give a better picture of the performance of them with regard to the rice marketing mechanism. A research was conducted in this regard to study the cost and expenditure and economic behavior of rice middlemen in the rice marketing process. This research was based on a sample of fifty middlemen selected through Purposive Sampling Technique. Locations were selected from major paddy/rice marketing areas in *Polonnaruwa*, *Maradagahamula*, *Dambulla* and *Colombo Pettah* market. Field survey was done using questionnaires after harvesting of 2005/06 *Maha* season. The collector plays a prominent role in rice marketing at *Polonnaruwa*. A collector cost consists of two

elements namely transport cost and packaging cost. Miller's cost consists of transport cost, cleaning cost, parboiling cost, drying cost and processing cost. The study revealed that miller's cost in *Polonnaruwa* is lower than other locations considered, because of lower transport cost of paddy to the mill from producing areas. Analysis of the expenditure for milled rice between the miller and whole sale market in *Maradaghamula*, *Dambulla* and Colombo *Pettah* market showed that the wholesaler cost is higher in Colombo *Pettah* market than other locations because of existence of a commission agent unlike of other two markets. Farm gate prices of paddy vary between Rs.10.00 to Rs.16.00 per 1Kg of paddy in *Polonnaruwa*. Accordingly marketing margin of millers varies between 38.0% to 9.99%, 29.79% to (-) 1.35% and 35.6% to 4.86% in *Polonnaruwa*, *Maradaghamula* and *Dambulla* respectively. Marketing margin of millers vary depending on the farm gate price of paddy. Marketing efficiency in Colombo *Pettah* market, *Maradaghamula* market and *Dambulla* market was analysed taking *Polonnaruwa* market as base. Marketing efficiency is higher in Colombo *Pettah* market than other markets, because of receives rice directly to Colombo *Pettah* market. For 1 kg of rice, collector, miller and Wholesaler spent Rs.0.67, Rs.2.99 and Rs. 0.16 respectively within marketing channel of *Polonnaruwa* to Colombo (*Pettah*) market. According to the study, processing paddy in the producing areas and transporting to the markets is more profitable than transporting paddy, because when paddy is transported, the cost includes transport of paddy husk. Increased milling out –turn can reduce the cost of milling and accordingly this can be used as tool for reducing rice prices.

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### **Changes in the world cocoa economy and their impact on Sri Lankan cocoa trade**

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Cocoa, the principal ingredient of chocolate, is mainly grown in West Africa, Central and South America and Asia. World cocoa bean production in 2005 was estimated as 3.2mn.t and Côte d'Ivoire, Ghana, Indonesia, Nigeria, Cameroon, Brazil, Ecuador and Malaysia were major producing countries. Annual grindings comprised to 3.3mn.t for which US contributed to 32%, followed by Germany, France and UK with 11.6%, 10.3% and 9.2% respectively. Recent setbacks in the international cocoa market have largely influenced cultivation, processing and marketing aspects of the Sri Lankan cocoa industry and the objective of the study was to investigate such changes and their impact on Sri Lankan cocoa sector. The world cocoa production showed a steady growth from 1.5mn.t with annual growth of 28000mt. in 1970-83 to 2.62mn.t with 78000t. per annum in 1984-2005. Consumption also followed a similar pattern and annual grindings increased from 1.47mn.t in 1970-84 to 2.4mn.t in 1985-2005. Annual increase in consumption was 7144t. per annum in 1970-79 and 71320t. in 1980-2005. Increased supply and demand overlapped each other and created a stagnating market with low prices. International price dropped from US\$ 2.6 per kilo with annual growth of US\$0.09 during 1970-86 to US\$1.38 per kilo in 1987-2004 with annual decline of US\$0.03. Farmers in small producing countries like Sri Lanka suffered heavily from such negative influences and local markets collapsed due to lower prices which were below the cost of production, reduced exports and increased imports. Poor premiums caused to diversify small scale cultivations into other crops or other activities leaving only unattended, large scale, less productive and senile plantations which cannot even fulfill the local demand. The shortage of raw material to the local chocolate industry forced government to remove the import restrictions imposed on cocoa. Imports, comprising both raw materials as well as finished and semi finished products, increased by 450% from 342t. in 1992 to 1905t. in 2005. Farm gate prices fell from Rs.58 per kilo in 1970's to Rs.38 per kilo in 1986-93. The exports dropped from 1371t. in 1982-91 to 137.5t in 1992-05. The above situation was common for many producing countries hence

it was forecasted that if current market stagnation continues the world production would drop in a decade or two resulting increase in price. Most favorable sign in recent cocoa import to Sri Lanka is increased share of raw material rather than the finished and semi finished chocolate products. However, there are no quality barriers for imports and the reported per kilo import price of raw material, in bean equivalent, was 225% higher than the local price. Hence the local cocoa industry still can keep up its position in the industrial development by supplying adequate quantity through more organized and efficient production drive and through improved market linkages.

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**713/F**

### **Floristic richness in salgala forest reserve, Sri Lanka**

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A remarkable feature in floristic diversity seen in Sri Lanka is that, 90% of its endemic species are confined to the rain forests found in the wet zone, having a land area of 15000 Km<sup>2</sup>. Study of the floristic richness of the isolated forests found in the wet zone has been identified as a fact of great importance and a needy intervention. Exploration floristic richness of the Salgala Forest Reserve, which is in fact an isolated floristic patch in the wet zone would be of great help to disclose the phytosociological information and the phytogeographical distribution, which were never been explored and made known so far. Salgala forest reserve encompassing an area of 127.8 ha, is located in Kegalle district in Sri Lanka. The absolute location is latitude 7° 6' 48" and 7° 7' 84" N and longitude 80° 14' 65" and 80° 15' 48" E. The main objective of the research is to explore the floristic richness of the Salgala forest reserve. There were two specific objectives. i) Identify individual species, families and endemic species in the forest. ii) Identify differences between floristic richness in each elevation.

The forest area was divided into three main zones according to the density of the forest, based on interpretation of a 1:5000 aerial photograph. Vegetation sampling was carried out in three transects within each zone. Located sample size is 10 m X 10 m and the gap between each contiguous samples were 200 m. Nineteen (19) samples were selected maintaining topographic heterogeneity. Over 10cm girth at breast height trees were enumerated.

Total number of 886 tree individuals was enumerated. A total of 29 families, 53 species and 23 endemic species were recorded. Both 221–260 m and 261–300 m elevations claim for highest number of families, each area containing 26(90%) out of a total of 29 families. A fewer number of floristic families 17(59%) out of 29 were identified at the elevation of 181–220 m. The highest number of species could be seen within the elevations of 221–260 m and 261–300 m, which were 37(70%) and 39(74%) respectively. Relatively lower number of species was identified at the elevation of 181–220 m. The largest number of endemic species was seen at the elevation of 261–300 m where 19(83%) out of a total 23 endemic species were recognized.

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714/F

**Exploring the motives for small & medium-scale fruit & vegetable processors in Sri Lanka to adopt a system of HACCP at the firm level**

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There is a widespread consensus amongst food technologists, economists, and policy makers that the most effective and economically efficient approach to enhance the quality and safety of food products is to adopt a quality metasystem such as Hazard Analysis & Critical Control Points (HACCP) at the firm level. In light of this, the entrepreneurs from agri-food processing sector in Sri Lanka are faced with the challenge of putting it into practice. This study was aimed to identify and quantify the factors that motivate agro entrepreneurs from the small and medium-scale fruit and vegetable processing firms in Sri Lanka to act in this respect. With a support of a structured questionnaire, a series of in-depth personnel interviews were conducted with quality assurance personnel from 27 enterprises from July to August 2006 to collect data, where the majority of firms were from the Western and North Western provinces. Using both the descriptive (e.g. Mean Importance Scores) and inferential statistical techniques (e.g. Factor Analysis based on Principal Component Analysis), those individual incentives identified were broadly categorized into four groups, namely: (1) external requirements and expectations, (2) regulations, (3) reputation and goodwill, and (4) internal efficiency. The outcome of cluster analysis, conducted subsequently, suggested that majority of these firms were motivated to implement HACCP by government regulation. As Sri Lanka does not yet impose any mandatory government regulation on implementing HACCP for any sort of industry, care must be taken to in such an attempt to motivate firms with appropriate market-based incentives too, for example tax relief, input subsidies, technical know-how, and effective educational programs so that such attempts would be fruitful by minimizing the plant and product exits and saving the tax-payers money involved with direct regulation.

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715/F

**Adoption of integrated pest management in small holder vegetable cultivation: A case study of family cruciferaceae crops**

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*Badulla* District is one of the major vegetable growing areas in Sri Lanka. Most of the farmers in *Badulla*, cultivate three seasons per year. One season for rice, one season for potato and other for vegetables. Excessive use of pesticide creates a number of environmental and health problems in this area. Therefore, integrated pest management (IPM) has been introduced to farmers to minimize pesticide usage. The main objective of this study was to identify the adoption of IPM in small holder vegetable cultivation mainly focused on family cruciferaceae crops. This was done in two major vegetable growing Divisional secretariat divisions (DSD) viz. *Welimada* and *Uva paranagama*. Four G.N. divisions; *Alakolagala*, *Hinnarangolla*, *Ranhavadigama* and *Dangolla* where the IPM programmes were implemented during last few years were selected and 17 farmers from each G.N. division were selected using simple random sampling technique.

The results revealed that the agricultural instructors of the provincial department of agriculture were the main extension service in the area. In addition, the pesticide companies were also engaged in doing extension services through their dealers, but it is subjected to benefits of their pesticide usage. Majority of the respondent farmers used pesticide before the initial stage of the pest attacks. They used much higher amount of pesticide than recommended. Nearly 44 % of the farmers have a good knowledge about IPM. Most of the farmers could identify the natural enemies of the cruciferacea pests. But 47 percent of the farmers had no idea about interaction between pests and their natural enemies. A high proportion of farmers (42.7%) have medium level knowledge about pest control methods. The highest proportion of the respondent farmers (44%) was low adopters of IPM. The relationship between age of the farmer and the adoption of IPM and, also the knowledge of the farmers and adoption of IPM were found to be significant. Eighty three percent of the farmers have poor attitudes towards IPM. They said IPM is not an effective method for control of pests and it is a time wasting method. So improving attitudes will help the farmers to adopt IPM practices. There are no farmer field schools in the selected area. So the farmer field schools approach would be useful to increase the knowledge and attitudes towards IPM. It also helps to share the experience with neighboring farmers.

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### **Economic valuation of home gardens of wet zone**

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Home gardens are widespread in the agro-forestry systems throughout the country. They play an important role in the household economy both in the dry zone and the wet zone. Of them the wet zone is a highly populated area in which a higher percentage of home gardens are also present. Also the wet zone home gardens are crucial ecosystems and are being depleted rapidly as they have not received the attention of the economists except for the Kandyan forest gardens. This study was carried out in order to estimate the economic value of home gardens in the WL -3 agro ecological region.

94 home gardens were selected randomly within the Gampaha and Colombo districts for the survey. A survey was carried out canvassing a questionnaire to collect information from the sampled home gardens. Information on the size of the home gardens, crop types, their extent, age and yield were collected for the estimation of the economic value of the home garden. Information on the respondents' socio economic characteristics was also collected. In order to find out the prices of the home garden produce a market survey was conducted in the area. The contribution of socio economic factors to the economic value was found out by a multiple regression analysis.

According to the results obtained, the mean economic value for a home garden is Rs.74,190 per annum whereas the mean economic value of the output per hectare per annum is Rs.418,228. Sizes of home gardens range between 0.05-0.80 ha. The composition of the crop mix varied according to the time period the residents have been living within the home garden. Results of the regression analysis showed that the socio economic factors such as duration of residence of the respondents' within the home garden, size of the home garden, maintenance cost, monthly income from employment and labour hours spent for the garden significantly contribute to the economic value of the home garden.

The results highlighted the importance of the home garden system in the WL3 agro ecological region for the household economy and the significance of recognizing that value in making decisions regarding home gardens.

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### **Modeling of home gardens in the wet zone low country for better economic gains**

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Home gardens in Sri Lanka play an important role in the household economy both in the dry zone and the wet zone. Wet zone home gardens are more diverse than those in the dry zone but they are being continuously replaced by settlement expansion and industrial development. Although the home gardens in the wet zone are crucial ecosystems their economic performance is not optimal. The poor performance of the gardens leads the owners to neglect the garden and subsequently convert them into other uses. This study was carried out in order to formulate the best home garden models with maximum benefits in the WL-3 agro ecological region.

94 home gardens were selected randomly within Gampaha and Colombo districts for the survey. A survey was carried out canvassing a questionnaire to collect information from the sampled home gardens. Information on the size of the home gardens, crop types, their extent, age, yield, were collected for the estimation of the economic value of the existing home gardens. Space and shade/light requirements of the tree crops were recorded. Best home garden models for land areas of 20, 40, 80, and 160 perches in extent with maximum benefits were formulated using the estimated economic values and the other physical requirements of the crops.

According to the results derived from these models it was seen that the use of the total extent of the home garden with monocultures gives a minimum economic benefit with less biodiversity when compared with the home gardens with a maximum number of crop species. The best garden with maximum returns per unit was 160 perch in extent with coconut and Gotukola a combination that provides over RS1 million as the annual income.

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**718/F**

### **Socio-economic impact of transferring from river sands to deposit sands with government policies: A case in lower Walawa valley**

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Key words: Walawa river valley, sand mining

Extraction of sand from river beds has become a serious threat to the environment and infrastructure during the last decade and intensified with the reconstruction of Tsunami damaged structures in the

Southern province. Recently, the government imposed strict rules and regulations regarding mining, transportation and related activities of sand mining. As a result, in the Walawa river basin, especially in Ambalantota area, mining activities were transferred from river to nearby sand deposits in agricultural and residential lands. This study focused on the impacts of sand deposit mining in the Ambalantota area. Almost all sand miners (32) engaged in deposit sand mining and river sand mining in the area, 18 land owners who have rented their lands for sand mining activities, 17 transporters of both river sand and deposit sand and investors in the industry were interviewed. In addition to that a sample of 25 affected farmers a sample of 25 general public and stake holders in several stages were interviewed to find the positive and negative impact on the affected party. The Wilcoxon sign rank test was employed to test the hypothesis of different impacts.

Results of the study revealed that 56% of the deposit sand miners were previously engaged in river sand mining while the rest were new comers reflecting the river sand mines have shifted away from river sand mining. The biggest issue in sand mining was the lowering of ground level and consequential drainage problem in agricultural and residential lands. Only in 62% of mining sites, the top soil removed is used to refill the mining pits while about 13% is used for brick the industry. The average on site prices of deposit sand and river sand were Rs. 2000.00 and Rs. 2300.00 respectively while prices for final buyers were Rs. 5000.00 and Rs. 5500.00 respectively. This price difference is mainly due to the poor quality of the deposit sand. The results of the Wilcoxon Sign Test revealed that the declining water table, soil erosion, crop damage, destruction of roads and increasing mosquito population were the major significant negative impacts while the increasing income for land owners, improvement of infrastructure in the area, employment generation and lowering the prices of sand for constructors were the main positive impacts.

It can be concluded that blanket rules and regulations on river sand mining and transportation has created on adverse impact on both the users of sand and other affected parties in the Walawa river basin.

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**719/F**

**Impact of the performance of G.C.E. (O/L) Mathematics on the subject combined Mathematics at the G.C.E. (A/L) Examination**

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In Sri Lanka, G.C.E (O/L) and G.C.E (A/L) are two important national level examinations conducted by the Department of Examination. Both are highly competitive examinations and the minimum entry requirement to follow Combined Mathematics (CM) at the AL is a credit pass in OL Mathematics. From the surveyed data it is noted that, island wide, 50 percent of the students have failed the OL mathematics during the period 1996 to 2000. Nevertheless students who studied in G.C.E (A/L) science stream achieved better performance in G.C.E (O/L) Mathematics (credit or distinction passes) but they all do not achieve good performance in the subject CM at the G.C.E (A/L). Thus it is an interesting task to investigate the level of correlation between the performances of the two subjects at the two important national level examinations. The objective of this research is to establish two performance indicators (PIM; PIC) as an educational measurement for the two subjects G.C.E (O/L) Mathematics and CM at the AL in respect of students who studied G.C.E (A/L) physical science stream and to find out whether there is a correlation between the performance indicators for the two subjects.

Survey research method was utilized in two stages: documentary survey (using charts) and opinion survey (using Likert – type opinionnaire). A sample of 624 students from National schools, 1AB schools, and 1C schools in the *Batticaloa* district was surveyed. Data were analyzed using quantitative and qualitative methods for the stratified random samples from the students' population. Correlation coefficients were calculated using statistical package for social studies (SPSS).

PIM is between 2.80 and 2.90 and it is accomplished to 3 ( $PIM \geq 2.80$ ); PIC is between 0.67 and 0.84 so it is not accomplished to 1 ( $PIC \leq 0.84$ ). Magnitude of Spearman's correlation coefficient ( $\rho$ ) = 0.332 which is significant at the .01 level (1-tailed). And the magnitude of the Pearson Correlation coefficient ( $r$ ) = 0.312 which is significant at the .01 level (1-tailed). Therefore 10 percent of explained variance in combined mathematics is predictable by the achievement in OL mathematics. Both yields are not the same as  $\rho = 0.332$ ,  $r = 0.312$ , but positive low values; difference is 0.020, in the case there are ties, the results need not be identical, but the difference will be insignificant. Thus the correlation-ship between OL mathematics and AL combined mathematics is low but positive. Success in combined mathematics by the achievement in OL mathematics is only 10 percent with respect to  $r$  and 11 percent with respect to  $\rho$ . Some other factors, about 90 percent (for  $r$ ) and 89 percent (for  $\rho$ ) influenced the achievement of combined mathematics such as difficulty in understanding concepts in combined mathematics, students' motivation, teachers' commitment, parents' commitment, learning environment, family income, family education, etc.

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**720/F**

**'Becoming Aware' : Do consciousness-raising study aides enhance  
adult language learning?**

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Metacognitive strategies are a way of consciously exercising the intellect and they have been found to be particularly useful in self-directed learning contexts, as in distance learning settings. Metacognitive skills involve the regulation of cognition – i.e. planning, monitoring and self-evaluation. Studies have revealed that adult English as a second language (ESL) learners, actively engage in monitoring. Furthermore, the 'Noticing Hypothesis' in language learning holds that learning without awareness is not possible and that learners need to '*notice*' a feature to acquire it. This study, through a post-test, seeks to find out whether actively using metacognitive strategies by engaging in a scaffolded consciousness-raising (C-R) activity that requires learners to '*notice*' linguistic features in their own output enhances adult language learning.

The '*learning*' was measured through the Final Examination (FE) performance of 64 adults who followed an academic English course at a university in Sri Lanka. Whilst following the course, taken in the distance mode, the learners engaged in two types of activities - one where they were required to self-evaluate and monitor their own output in relation to a '*model feed-back*' sheet provided and the other, where they had to obtain task knowledge by participating in continuous assessment (CA) tests. The former required learners to consciously use metacognitive strategies to obtain task knowledge while the use of such strategies is more implicit in the latter, as learners were not provided with explicit guidance.

The learners who engaged in the C-R activity obtained higher overall FE scores and perform better in writing than those who did not engage in this task. The correlation between engaging in the C-R

activity and FE scores is statistically significant. On the other hand, there was no significant correlation between FE scores and participating in the task requiring the implicit use of metacognitive strategies. The correlation between the FE score and engaging in both activities or engaging in neither was not statistically significant either.

Therefore it appears that scaffolded C-R tasks which require the explicit use of metacognitive and cognitive strategies (such as deduction and self-evaluation) positively impacts on adult ESL learning (undertaken in the distance mode) in Sri Lanka while implicit task knowledge gained through sitting for CA tests (a non-scaffolded task) does not make such an impact.

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## **721/F**

### **Employability of food science and nutrition graduates and relevance of the degree programme in their performance in job and real life**

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Although the employment rate of Sri Lankan graduates in general has been estimated at 88% still the employability of the graduates is a burning issue in Sri Lanka. The Food Science and Nutrition degree programme offered by the Faculty of Livestock, Fisheries and Nutrition at Wayamba University of Sri Lanka has been implemented since 2001. This contains a number of course modules in the study disciplines of food science, applied nutrition, livestock sciences, aquaculture and fisheries. One full cycle of implementation of the curriculum was completed in 2006.

In the present study fifty-two graduates representing all specialization streams were surveyed to determine the employment rate and average job seeking time, to identify major graduate employment categories, to identify their job responsibilities at the place of work and to assess the relevance of the food science and nutrition degree programme in their job performance and real life.

The employment rate of the food science and nutrition graduates was 86% where as the average job seeking time was two months from the completion of the degree. Most of the graduates were employed in the area of quality assurance (34%). The probable reason behind the higher employability in this category is the government policy changes to cater to the emerging requirements of the European Union with respect to the imported food items. Other major job categories in which the graduates were employed include non government organization and extension services sector (17.5%), marketing (12%), farm management (6%) and dieticians/health councilors (5%). Sixty percent of the respondents were employed in the areas which are not directly related to their specialization stream. The job responsibilities common for most of the job categories include maintenance of quality assurance aspects, staff training, work supervision, laboratory testing and supportive role in administrative functions. The respondents believed that most of the compulsory courses in the curriculum including the basic courses offered during first two years were more helpful in performing their job responsibilities effectively. They believed that the courses on human nutrition were important in their real life. They found the supplementary courses such as information technology, statistics and mathematics, English language, etc. have a higher influence in performing the responsibilities of the job as well as in their day to day life.

It is recommended to consider the outcomes of the present survey in the future curriculum revision of the faculty. Also the outcomes will be useful in deciding the direction of future degree programmes in the biological steam.

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**722/F**

### **Food science and nutrition undergraduates' expectations in English language and IT learning during their university undergraduate education**

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English language proficiency and fluency in Information Technology have become essential elements of undergraduate education in Sri Lanka as these skills are highly valued by employers. The food science and nutrition degree programme at Wayamba University of Sri Lanka is entirely conducted in the English medium. In addition, English language courses have been included into the curriculum throughout the study programme, to enhance English language proficiency of graduates. The degree programme also offers a general IT course.

The present survey was carried out to find out students' expectations in IT and English language learning. 62 undergraduates in the 1<sup>st</sup> and 3<sup>rd</sup> academic years of the degree programme were surveyed using a pre tested questionnaire.

Most of the respondents believed that they did not have opportunities to speak English with other people (80.52%) during the English lessons at school. The difficulties they faced at the university was the inability to speak English fluently (71%), difficulties in reading scientific texts (48%) and difficulties in presentations (36%). The most desired abilities of the students in the undergraduate English programme was the ability to speak English fluently (82%) followed by the ability to make presentations in English (77.5%). The opportunities students missed at school, their present difficulties in English and the abilities that they claim to have in English seems to be correlated with their ability to speak English. 78% of the respondents believed that the present English language programme conducted by the English Language Unit of the university was at or above satisfactory level and 22% of them were dissatisfied mainly due to irrelevant lesson materials and unproductive learning activities. Most of them preferred to practice speeches and oral presentations (79%), carry out listening exercises on radio and TV news broadcasts (64%) and express opinions on various matters (58%) in their English lessons.

72 percent of the respondents were familiar with the MS Office software packages before they entered the university while they were less familiar with other areas of the IT course in the degree programme. 93 percent of the respondents were willing to follow another well structured IT course which covers Management Information Systems and advanced aspects of the contents in the IT course they had already followed, e – commerce, Project Management, Graphic Designing and Web Development.

It is recommended that the outcomes of the present survey be considered in the revision of the curriculum of the faculty in the future.

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**723/F**

### **Examining social presence in an online learning environment of adult learners**

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Educational institutions, especially to offer courses in the distance mode, are increasingly adopting online learning methods. However, the lack of face-to-face interactions in a typical text-based online learning environment could create a feeling of social isolation among the learners, resulting in a negative learning experience. Social presence is identified as an important factor that helps people to actively collaborate in an online learning environment. It is the ability of participants to present themselves as “real persons” in an online learning environment, and is considered to be an element of interpersonal communication between learners. This paper describes a study that examined the development of social presence among a group of adult learners, in an online learning environment. The investigation focused on the following research questions: What are the types of social presence observed in the online learning environment? What is the effect of social presence on the learners? and, What is the role of the instructor in creating social presence?

A case study method was used in this study. The participants were a group of teacher educators who followed a professional development programme in the distance mode. Multiple techniques such as content analysis of the transcripts of learners’ postings in the discussion fora, questionnaire and interviews were used for data collection. Participants had used different techniques of social presence in varying degrees. Expression of emotions and feelings, sharing frustrations and satisfactions, supporting each other and stating humorous comments were the mostly observed social presence styles. The “connectedness” with their peers and the feeling of “not being alone” was a highly motivating, and a supportive factor, for learners to move along in the learning process.

Social presence has been a crucial factor which supported the learners to engage themselves in their learning at a distance, in the online learning environment. Social isolation was kept to a minimum, despite the physical separation of learners. Collaborative learning among learners was highly enhanced by social presence, and resulted in creating a closely-bonded learning community. The role of the instructor as a facilitator in building up social presence in an online learning environment is very important.

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**724/F**

### **Use of analogies in learning chemistry**

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Learning chemistry is related to the abstract nature of the subject content, which is characterized by chemical processes, and entities that are microscopic. This makes it difficult for students to comprehend the subject. In regular classrooms students who do not readily visualize or think in terms of abstract levels find it more the difficult to learn the subject. The aim of this study is to use analogies in teaching to help students to understand the abstract nature of concepts in an interesting and a

simple way. The study used a qualitative approach to understand how students learn through observations, interviews and documents.

The study was conducted in three phases. In the first phase a classroom was observed in an urban school when teaching chemistry lessons on the sub topic “Chemical equilibrium” of the unit twelve of the G.C.E. Advanced Level chemistry syllabus. By triangulating the collected data it was found out that analogies were rarely and effectively used in teaching chemistry. During the second phase of the study lessons with activities based on analogies were planned to provide visualization of the abstract nature of concepts relating to real world applications while making connections to the students prior knowledge. Discussions were had with the teachers who planned to implement the prepared lessons in order to get a clear understanding of the analogies. In the third phase of the study, planned lessons were tried out in two classrooms in two other urban schools.

In the implementation of prepared lessons, teachers used analogies for explanation. They were also able to give some other analogies for the practice of individual students who indicated a lack of understanding. The analogies presented had a motivational impact on the students. Students were attentive and actively involved in the lessons. They were able to understand the meaning of what they had learned in the classroom. In addition to that each teacher had a good interaction with his or her students. It is recommended that teachers should develop useful analogies and also select those analogies that could be related to the student’s own experience.

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**725/F**

### **Team efforts of teachers for their own capacity building**

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Learning occurs in a social environment. Teaching and learning is a plural activity. In schools, teachers plan their lessons without consultation of peers and others. Generally, they do not consider the content in the previous grade and the next grade. This study presents how a primary teacher has changed her practice with guidance and collaborative efforts with special emphasis on continuity of a theme across grades. At the primary level the curriculum is developed under themes and it is competency-based. A rural school was selected for the study considering the convenience of the researcher. Majority of the students came from the lower middle class. Five teachers from grades one to five in the same school were observed for two weeks to get an understanding of how teachers plan and implement lessons in the subject Environment Related Activities (ERA.) Detailed notes of observations were taken down to identify weaknesses in planning and teaching. The researcher had meetings with the sectional head and with the teachers of the same grade and all primary teachers. With the intervention of the researcher, teachers planned lessons for a theme staying after the school closed. In this activity they shared their ideas together. Special attention was given to study the subject content of all five grades on the same theme. While following the guidelines given in the teacher guides, teachers investigated ways of presenting the lesson to match their content involving students in various activities. The researcher observed how teachers implemented these lessons in their classrooms. The study made them confident in using multiple ways of teaching to make all students in to active participants. Above all, they expressed the relief they had in limiting the content to the grade level, knowing how concepts would be built up across grades. They made it a practice to plan lessons together. Collaborative efforts help teachers to improve the practice and for learners to learn with understanding. Collaborative learning relies on social interactions of students.

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**726/F**

### **Potential applicability of the concept of a sustainable city in Sri Lanka: A review**

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Urban areas produce a series of environmental problems that arise from the consumption of natural resources and the consequent generation of waste and pollution. These problems are continuing to grow, new solutions, without adverse effects, therefore need to be developed in order to maintain the quality of life desired by the community. This paper reviews the applicability of the concept of a sustainable city within the Sri Lankan context and explores the policy changes required for adoption of the concept.

Many cities tend to be large consumers of goods and services, while draining resources out of external regions that they depend on. As a result of the increasing consumption of resources, and growing dependencies on trade, the ecological impact of cities extends beyond their geographic locations. The main objective of the study was to explore the components of the concept of a sustainable city, and to investigate their applicability in selected sectors of the country.

The study involved a survey of available literature on the concept of a sustainable city and investigated the main concepts applicable in three main areas, namely, transport, energy and waste management. The survey was extended to incorporate measurement indicators and their applicability as well. This information was then matched with the existing sustainable strategies of the above mentioned sectors and the potential of the incorporation of the concept was explored.

The results revealed the important components of the concept of a sustainable city including ecological, cultural, political, institutional, social and economic components. The existing sustainable strategies have been limited only to the areas of waste and energy sectors within the urban sectors of Sri Lanka. System level indicators, targets and policy instruments have been identified, that could be immediately applied within the Sri Lankan city context.

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**727/F**

### **Motivation as the key issue in human resource management (HRM): The agricultural graduates' perspective**

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Most agricultural graduates are employed in private and public sector organizations. They render services for organization as well as for their career development. Motivation is one of the most effective Human Resource Management (HRM) issues that help organizations to cope with changes while pursuing employees to work with maximum efficiency and with high job satisfaction. But most

organizations less adapt to motivation practices as key HRM issues. Therefore main objectives of study were to evaluate current HRM functions in private and public sector organizations in Agricultural graduates' perspectives, to identify key areas of HRM within organizations required to be developed to promote career of agricultural graduates, To measure importance of motivation as a key indicator to measure employees efficiency within organizations in order to ensure greater service and increase employees' satisfaction.

Sample was consisted of 100 agricultural graduates and they represented both private and public sector organizations. Primary data were collected using semi structured questionnaire and motivation was measured using direct interview methods. Study revealed that, motivation is key factor for efficiency of employees within organization. However, both private and public sector organizations give less motivation for employees. Private organizations give comparatively higher motivation to achieve organizational goals than by public organizations. Self motivation is most effective method that helps employees to work in organizations with high job satisfaction. Public organizations' employees have some limitations for personal career development. Few semi government organizations have been presently started to motivate employees for better job performances.

Employees develop their career by comparing with personal development of peers, and build up working satisfaction by themselves. Flexible working environment is one of the motivators for even though they have not been motivated in other terms. Understandings of employees' needs, flexibility to work with creativity, feed back for performances, and appreciations for best performances by management are kind of strong motivators. Perspective of employees in organizations is that considerable motivation within organization is required for better performances. Self motivation is not very effective in organizational point of view. At the end of each year some organizations hold annual awards ceremony to acknowledge well performed employees, continues attendees and innovators. Given awards are promotions, monetary awards, and rewards given in addition to basic salary/wage. Motivation method through awards and rewards seems to be a successful strategy and employees have been well motivated through this method.

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**728/F**

### **Analysis of the internal marketing practice in Sri Lankan organizations**

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The study has reviewed the practice of Internal Marketing in Sri Lankan organizations. Internal Marketing is said to play a vital role in an organization in getting the optimum output of the human capital. The emphasis on human capital is essential to stay ahead of extreme competition and to obtain the competitive advantage. The specific objectives of the study were to observe and identify the employee perception based on the practice of internal marketing in organizations, to analyse employee perception on the focus of key results areas by the selected organizations, and to draw conclusions and make observations for an improved practice of internal marketing by the organizations. Data collection was conducted by administering a questionnaire. Eight entities were selected across Sri Lankan organizations. Hundred and twenty-four (124) employees/respondents were selected for the study, based on structured random sampling. Key individuals were interviewed and observations were made to verify the findings. Excel and SPSS computer packages were used for data analysis and tabular representations have been made. Correlations and regression analysis were tested among the key variables to make relationships.

The respondents' perception with regard to the focus and the practice of internal marketing practices in the organizations were noted. Awareness of the importance of adopting internal marketing practices was at a lower level in the selected organizations. The level of employee job satisfaction and the factors contributing to the same were sought. Nature of work itself was perceived to be the main contributory factor for job satisfaction. The respondents' perception on the internal marketing practices was significantly correlated to their levels of job satisfaction. Respondents perceived major strengths and weaknesses at their places of work. Employee suggestions on improving the performance of respective organizations were analysed. The author has made observations for the improved performance of organizations that were under review.

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## POSTERS

### SECTION A

#### 201/A

#### **A preliminary study on anti-bacterial effect of Ayurvedic compound preparation of Buddaraja kalka**

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Buddaraja kalka is a herbo mineral preparation used in Ayurvedic system of medicine over several hundred years, which contain sixteen herbs and ten minerals. This compound preparation is mainly used for respiratory tract diseases. The objective of this study was to evaluate the antibacterial effect of this drug. Three market samples with different manufacturing dates were selected. Single human dose of 500mg was dissolved in sterile distilled water and shaken at 160 rpm for 04 hours to get the maximum soluble liquid extract. Nutrient broth and Nutrient agar were prepared and sterilized according to the Oxoid manual. Already plated pure test cultures of *Escherichia coli* (NCTC-009002) *Salmonella typhi* (NCTC-005714) *Staphylococcus aureus* (NCTC-006571) *Pseudomonas aeruginosa* (NCTC-010332) and *Bacillus cereus* (NCTC008035)- were inoculated into tubes containing 5 ml of sterile nutrient broth and incubated at 37 °C for 18 to 20 hours. Sterilized nutrient agar was transferred into sterilized Petri dishes at 40 °C and allowed to solidify on a horizontal plane and kept in incubator at 37°C for 24 hours to exclude any contaminations and to reduce the moisture content. A known amount (0.05 ml) of each test culture broth containing specific organisms was added to these solidified agar plates separately (Two plates per each test organism) and spread evenly using a sterilized glass spreader. Well diffusion method (10 mm x 5mm wells) was used to study the effect of the drug. These wells were filled with 0.1 ml of above liquid extract of the drug. Deionized sterilized distilled water 0.1 ml and 0.1 ml of Gentamicin, which contain Gentamicin 25 mg per ml, were used control. These plates were sealed and incubated at 37°C for 24 hours. This same procedure was repeated three times with different samples. For each of the test organism Gentamicin showed 10 mm -15 mm clear inhibition zones of the bacterial lawns of with Buddaraja kalka, *Salmonella typhi*, and *Escherichia coli* plates did not show any anti-bacterial effect while *Pseudomonas aeruginosa* plate showed 6mm and *Staphylococcus aureus*, and *Bacillus cereus* plates showed 5 mm clear inhibition zones of the bacterial lawns on every repetition. These results were statistically analyzed by using one sample student T-Test. All the means are in between accepted levels and P value is <0.05. Comparison to Gentamicin. The Buddaraja kalka is active against *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Bacillus cereus*. This preliminary study scientifically justifies the use of Buddaraja kalka in respiratory tract infections.

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#### 202/A

#### **LD<sub>50</sub> of venom of *Bungarus ceylonicus* (Ceylon krait) following an intramuscular injection to mice**

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Sri Lanka is a country, which is reported to have a very high incidence of snakebites. Out of the two species of kraits found in Sri Lanka, *Bungarus ceylonicus* is endemic to Sri Lanka. The objective of the study is to determine the LD<sub>50</sub> of the *Bungarus ceylonicus* venom following intramuscular injection and to compare it with the LD<sub>50</sub> of *Bungarus caeruleus* venom.

Venom was obtained from adult snakes from the two species under investigation. Protein concentration of the crude venom was assessed and stored in Phosphate Buffered Saline pH 5.2 at -80°C. Venom from *Bungarus caeruleus* and *Bungarus ceylonicus* was injected at concentrations 0.5, 1.0, 2, 4, 6, 7.5, 8, 10 µg/mouse intramuscularly to groups of Balb C (*Mus minimus*) mice. The mice were observed closely for 24 hours. The time of death since injection of venom was recorded.

At 24 hours following injection, in the group injected with *Bungarus ceylonicus* venom, all mice managed to survive at concentrations below 4 µg/mouse and half of the group died at 7.5 µg/mouse. In the group injected with *Bungarus caeruleus* venom, all mice survived at concentration of 0.5 µg/mouse, five out of ten mice survived at concentration of 1.0 µg/mouse. At concentrations above this level none of the mice were managed to survive for 24 hrs. All the mice that could not survive were died in less than 6 hours and the time duration was shorter with higher concentrations of venom.

The LD<sub>50</sub> of *Bungarus caeruleus* venom following an intravenous injection into mice was determined as 1.9 µg in a previous study. In our study LD<sub>50</sub> of *Bungarus caeruleus* venom following an intramuscular injection into mice was found to be much lower and was 1 µg. LD<sub>50</sub> of venom of *Bungarus ceylonicus* snakes has not been documented up to date and in our study this was found to be 7.5 µg, which is significantly higher than *Bungarus caeruleus*. The time of death since injection of venom was less than 6 hours. This could be due to the potent neurotoxins in the krait venom.

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**203/A**

**Incidence and distribution of antisperm antibodies (ASA) in male and female subjects undergoing subfertility treatment at a selected centre.**

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The presence of naturally occurring antibodies against antigens in the gametes can reduce fecundity in both males and females. In subfertile males, Antisperm antibodies (ASA) may be detected on the surface of spermatozoa, seminal plasma and serum and in females it may be detected in cervical mucus, serum and follicular fluid. However, after decades of study, the relationship between the presence of ASA and infertility continues to be disputed. In Sri-Lanka data relating to the incidence of ASA and its effect to subfertility is scarce.

In this present study we have investigated the presence of ASA using SpermMar immunobead test in subfertile males and females who seek treatment at 'Prarthana', Centre for ART, Nawala, during 01.01.2006 – 31.12.2006. ASA IgA and IgG is checked on the surface of spermatozoa, in seminal plasma and in serum of male subjects and in cervical mucus, serum and follicular fluid –FF (undergoing In Vitro Fertilization) of female subjects. FF taken without flushing of follicles.

Eleven out of 55 (20%) male subfertile subjects and 05 out of 55 (9.09%) female subfertile subjects had significantly positive ASA level. Total positive number is taken if at least one sample is positive for either IgA or IgG. In positive males 10 out of 11(90.9%) showed ASA either on spermatozoa or seminal plasma or in both. Only one (9.09%) serum sample was positive for ASA. In positive females 3 out of 5 (60%) showed ASA in cervical mucus and 2 (40%) had ASA in both serum and FF.

It has been demonstrated that ASA in female can impair sperm migration in the female genital tract particularly in cervical mucus and uterine cavity through fallopian tubes and also it is reported that inhibitory effects on fertilization and post fertilization events. ASA in males has a negative effect on the spermatozoa motility in the semen, on their ability to pass through female genital secretions etc. One method available at present to overcome the potentially deleterious effects of ASA-mediated subfertility includes Assisted Reproductive Technologies. In this study we observed the incidence of ASA is as high as 20% in subfertile males and 9% in subfertile females. And also ASA are mostly detected in semen in males and in cervical mucus in females. Therefore, we conclude that it is important to screen subfertile couples for ASA as a routine test to direct them to proper treatment modalities. This study will also provide basic ASA prevalence figures for any future references.

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**204/A**

#### **Quantification of essential metals in selected herbal wines**

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*Arishta* and *Asava* are widely consumed Ayurvedic herbal beverages. *Arishta and Asava* in moderate quantities are consumed daily to reduce tiredness and for longevity of the individuals. Use of plant materials and addition of minerals and sweeten materials during the manufacturing process can contribute to the presence of different types of metals in these products. Analysis of these metals to provide data for human consumption is important to ensure their safety and for the purposes of standardization of these products.

Hence the concentrations of essential metals, K, Ca, Mg, Na, Fe, Mn, Zn and Cu were determined in 12 brands each of *Ashvagandarista* and *Aravindasava*. 10 cm<sup>3</sup> of these preparations were subjected to wet digestion prior to flame and graphite furnace atomic absorption determinations.

Quantitative determination of the above essential metals in 12 brands of *Ashvagandharishta* showed the presence of Fe (min 0.00 mg/ml, max 0.02 mg/ml, mean 0.01 ± 0.005 mg/ml), Na (min 0.24 mg/ml, max 0.61 mg/ml, mean 0.39 ± 0.12 mg/ml), K (min 0.76 mg/ml, max 1.50 mg/ml, mean 1.16 ± 0.24 mg/ml), Mg (min 0.28 mg/ml, max 0.60 mg/ml, mean 0.48 ± 0.14 mg/ml), Zn (min 0.95 µg/ml, max 3.60 µg/ml, mean 1.44 ± 0.72 µg/ml), Mn (min 2.00 µg/ml, max 10.00 µg/ml, mean 4.00 ± 2.00 µg/ml) and Cu (min 0.33 µg/ml, max 0.74 µg/ml, mean 0.48 ± 0.14 µg/ml) in all brands of *arishta*. Corresponding values in the 12 brands of *Aravindasava* were Fe (min 0.00 mg/ml, max 0.03 mg/ml, mean 0.01 ± 0.005 mg/ml), Na (min 0.15 mg/ml, max 0.56 mg/ml, mean 0.34 ± 0.13 mg/ml), K (min 0.68 mg/ml, max 1.57 mg/ml, mean 1.00 ± 0.03 mg/ml), Mg (min 0.28 mg/ml, max 0.56 mg/ml, mean 0.39 ± 0.08 mg/ml), Zn (min 0.18 µg/ml, max 9.90 µg/ml, mean 2.69 ± 1.18 µg/ml), Mn (min 1.00 µg/ml, max 6.00 µg/ml, mean 3.00 ± 2.00 µg/ml) and Cu (min 0.10 µg/ml, max 0.62 µg/ml, mean 0.42

± 0.10 µg/ml). Results demonstrate that both types of preparations contain fairly similar concentrations of metals in solutions.

If a person consumes a maximum dosage of 10 ml of these preparations at a time for 3 times a day the intake levels of essential metals do not exceed the daily recommended allowances of these metals for an adult.

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## 205/A

### Assessment of ethyl acetate in selected Ayurvedic pharmaceuticals

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Ayurvedic pharmaceutical preparations named *Asava* and *Arishta* are consumed as medicines, appetizers, vigour tonics and herbal wines. About 35 *Arishtas* and 25 *Asavas* have been mentioned in official Ayurveda pharmacopoeia.

As fermentation is the major process by which these preparations are manufactured, ethyl acetate is a major constituent found in them, along with other secondary components. Ethyl acetate contributes significantly to the objectionable quantities in fermented solutions or alcoholic beverages. Ethyl acetate has a significant effect on the organoleptic characteristics of wines and distillates. The manufacturing process of *Arisha* and *Asava* is almost similar to the fermentation done in wine making. Hence the concentration of ethyl acetate in 16 brands each of commercially available *Ashvagandarista*, which can be bought without prescriptions, and *Aravindasava*, which is specially used in the treatment of children's disorders, was determined using Gas Chromatographic (GC) methods. 30 cm<sup>3</sup> aliquots of the product were distilled and the total distillate was used for the analysis. The concentration of ethyl acetate in different brands of *Ashvagandarista* varied from a minimum of 26.43 ppm, maximum 221.36 ppm and with the average of 107.92 ± 70.38. In *Aravindasava*, the corresponding values were 34.12 ppm minimum, 223.94 ppm maximum and 129.14 ± 58.92 ppm the average.

Observed variations of ethyl acetate in different brand of preparations can result in dissimilarity of organoleptic characteristics of products. Hence it is necessary to identify methods to maintain and control these constituents in a minimal level in Ayurvedic pharmaceutical preparations that were investigated.

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206/A

### **An entomological assessment of transmission of *Wuchereria bancrofti* in selected localities of the Gampaha district**

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Lymphatic Filariasis (LF) is the leading cause of lymphoedema worldwide, affecting an estimated 120 million people. Gampaha, which is outside the filarial belt in Sri Lanka, has been found to have higher endemicity of filariasis and was included in the National Filariasis Control Program. Entomological surveys are critical for evaluation of filarial transmission in any endemic area. This study was carried out to determine the current status regarding the transmission of *Wuchereria bancrofti* in the Gampaha district. Fifteen study sites were selected in 5 MOH areas in the Gampaha District, based on data obtained from the regional Anti-Filariasis Campaign (AFC) office. Mosquito collections were carried out in 20 households in each site. Conventional dissection and microscopic examination were used for detecting filarial parasites in mosquitoes. The results indicated that 73.33% (11/15) sites were infested with *Culex quinquefasciatus* mosquitoes positive for *W. bancrofti*. An infection rate of 2.22% (61/2740) was observed among the mosquitoes caught from the households. A mean larval (L1) density of 19.65 per positive mosquito was observed. The study confirmed that active transmission of *Wuchereria bancrofti* is currently taking place in the Gampaha district. Therefore, control programs to interrupt transmission need to be continued in this district.

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207/A

### **Comparison of a glucometer and an enzymatic assay values of blood glucose during assessment of glycaemic indices: A preliminary study**

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There is published data that shows the unsuitability of certain glucometers in determining Glycaemic Index (GI) values. Therefore this study was designed to evaluate the efficacy and reliability of using Accu Check Active glucometer, which is available in Sri Lanka to estimate blood glucose concentrations to determine the glycaemic indices of some meals and to compare these values with the values obtained with conventional enzymatic kit method.

GI of three meals i.e. a) red rice (AT 353, RRI, Batalegoda) with kirihodi b) same rice variety with kirihodi, dhal curry, egg, gotukola sambol and c) string hoppers (100% wheat flour) with kirihodi, egg, coconut sambol were determined. Healthy volunteers, both male and female (N = 10, age - 22-30) participated in the study. Capillary blood samples were taken from the volunteers after an overnight fast (10 –12 hours). The first drop of capillary blood was kept on a test strip, to obtain the blood glucose concentration. The test strip gave a colour change on application of a drop of blood by glucose dye oxidoreductase mediator reaction. Further blood samples and glucometer readings were

taken at 30, 45, 60, 90, and 120 minute intervals after consuming 50 g digestible carbohydrate portion of the above food items. Prima crust top bread was used as the standard. The GI values (Table 1) calculated using the glucometer readings were compared with the values obtained from a glucose oxidase kit method (GOD-PAP).

Table 1: GI values (Mean  $\pm$  SEM)

Item	Glucose kit values	Glucometer values	P value (< 0.05)
Red rice (AT 353)	99 $\pm$ 10	90 $\pm$ 11	0.2
Red rice (AT 353) meal	62 $\pm$ 6	55 $\pm$ 8	0.1
String hopper meal	104 $\pm$ 11	99 $\pm$ 12	0.1

Mean GI values obtained with the two techniques were not significantly different ( $p < 0.05$ ). However, we noticed the tendency of the GI obtained with glucometer to be lower than that of the kit assay. According to the data obtained, no discrepancy was seen when the GI values were determined by the Accu Check Active glucometer with the enzymatic method.

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**208/A**

### Blood glucose responses to selected bread varieties

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Glycaemic index (GI) concept categorizes food items according to their influence on blood glucose response following a meal. It is reported that the consumption of food items with low to moderate GI helps in the dietary management of diabetes, cardiovascular disease and cancer. Recent studies indicate a rapidly increasing prevalence of diabetes among both the rural (8%) and urban populations (12%) in Sri Lanka. This might be due to the change of traditional food habits from rice-based meals to wheat-based products such as different varieties of bread. Therefore this study was designed to estimate the glycaemic responses to frequently consumed different varieties of bread i.e. Prima crust top bread, whole meal bread (enriched with bran), bakery bread (all three with 72% extraction rate) and a meal containing whole meal bread consumed with dhal curry. Healthy volunteers, both male and female (N = 10, age - 22-30) participated in the study. Blood glucose concentrations were estimated using an enzymatic method (GOD-PAP). GI was calculated according to the FAO/WHO recommendations using both Prima crust top bread and glucose as the standards.

Table 1: GI values (Mean  $\pm$  SEM) with the two standards

Food item	Prima crust top bread (Standard)	Glucose (standard)
Prima crust top bread	Standard	77 $\pm$ 6
Whole meal bread	103 $\pm$ 10	77 $\pm$ 6
Bakery bread	114 $\pm$ 11	80 $\pm$ 4
Whole meal bread + dhal curry	87 $\pm$ 6	61 $\pm$ 6

When the GI values obtained with glucose and prima crust top bread as standards were compared a ratio of 1.36, which is comparable with international literature was obtained. The glycaemic responses of the three bread varieties were not significantly different ( $p < 0.05$ ). The whole meal bread when

consumed with dhal curry (mixed meal) produced lower peaks compared with the bread varieties consumed separately and only the mixed meal can be categorized into the medium GI food group while the other bread varieties belong to the high GI food class.

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**209/A**

### **Recent outbreak of hepatitis A in Gampola, Sri Lanka.**

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Infection due to Hepatitis A virus (HAV) is clinically indistinguishable from disease caused by other hepatitis viruses. Therefore, serologic testing is required for early confirmation of diagnosis. The prevalence of this disease is closely related to socioeconomic status of the population. An outbreak of hepatitis A like illness was reported in Gampola area in Kandy district affecting hundreds of patients. Our objective was to investigate for the aetiological agents for this outbreak and to study the clinical manifestations and factors contributed to the spread of illness. Venous blood samples were collected from 32 suspected patients hospitalized due to hepatitis A like illness at the Gampola base hospital. Laboratory diagnosis was made by using anti-HAV IgM ELISA. Clinical and socio-economic information were obtained through an interviewer administered questionnaire. Of 22 suspected cases, (mean age =21) 91 % (n=20) were confirmed for HAV by IgM ELISA. Among them, 80 % (n=16) were males. The typical manifestations of acute hepatitis such as nausea/vomiting, loss of appetite, abdominal pain, fever, jaundice and dark urine were observed in 86 %, 90 %, 80 %, 90 %, 60 % and 100 % of confirmed patients respectively. The source of HAV infection was most likely to be either from their working places (50 %, n=10) and restaurants (35 %, n=7) or from an infected family member (15%, n=3). The majority (70 %, n=14) of these patients had been using municipal tap water without boiling. All of them had been using water-sealed toilets. Only 30 % of patients had educated beyond O/L, 80 % (n=16) of the confirmed patients, the monthly income was less than Rs. 15,000.00. The average number of members of each family was 5. The majority (90 %) of them lived in houses with 2-3 rooms. Results suggest that the recent outbreak in Gampola area was hepatitis A. This illness was most likely to be due to poor hygienic practices and lack of background knowledge about this disease in the population.

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## SECTION B

### 210/B

#### Maturity indices of nutmeg (*Myristica fragrans* Houtt.)

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Nutmeg, *Myristica fragrans* Houtt. is one of the most important export agricultural crops of Sri Lanka. Nutmeg is the only spice crop, which gives two products from a fruit namely- nutmeg seed and mace. A serious problem in the industry is immature harvesting of nutmeg fruits for the market. This affects the yield and the quality of the product. Therefore identification of maturity indices is important to harvest nutmeg at correct stages of maturity.

Fruits were labelled at the time of fruit initiation and harvested at 1 month intervals from 1<sup>st</sup> month of fruit initiation up to 8 months. The experiment was set according to the Completely Randomized Design (CRD) with 9 replicates for each age group. As the mean separation procedure Duncan's Multiple Range Test (DMRT) was used. Maturity indices (colour of the fruit rind, seed and mace, fresh weight of fruit, rind, seed and mace, volume, diameter, moisture content of seed and mace) were determined.

Colour changes were visually observed with the maturity and a colour code was prepared. Fresh weight of whole fruit and rind increased significantly at  $P=0.001$  with maturity. The highest weights were 74 g and 55 g respectively in 8 month old fruits. Seed weight increased significantly at  $P=0.0001$  up to 5  $\frac{1}{2}$  months and gradually declined. Mean diameter and volume were significantly increased at  $P=0.0001$  with maturity. The mean values of above mentioned parameters at 8 month old fruits were 55 mm and  $7.6 \times 10^{-5} \text{ m}^3$ . Mean moisture contents significantly decreased at  $P=0.0001$  with maturity in seed and mace. Highest moisture contents were 18 % and 56 % respectively in mace and seed at 4 months.

To obtain the best quality product and the highest income when nutmeg is sold for seed or mace the most suitable time period is the fully mature stage (8 month).

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### 211/B

#### Incidence of *Antigastra catalaunalis* Dup. (sesame webworm) (Lepidoptera: Pyralidae) at Aralaganwila in the North Central Province of Sri Lanka

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*Antigastra catalaunalis* Duponchel (Lepidoptera: Pyralidae) was identified as the most important pest of sesame, *Sesamum indicum* crop in extensively cultivated areas in Sri Lanka. Farmers usually ignore pest incidences, as they cannot afford control measures. Seasonality of larval population and damage was monitored on biweekly intervals in monthly-planted 3 sesame plots that were maintained

under pesticide free conditions in the research field at the Regional Agricultural Research and Development Center, Aralaganwila. The larval population and damage were slightly higher during mid February to mid April and reached a higher peak during the period from mid June to September. The larval damages, webbing of leaves, defoliation, eating of flower buds and flowers and pod boring were most severe during the peak period and lower during the rest of the periods. Larval infestation was 39% and 32% on young seedlings at 3 and 5 weeks after sowing (WAS) and 9% when the crop was at blooming (7 WAS) and flowering (9 WAS) stage and 7% and 3% at 11 and 13 weeks age (in older crop). *Trathala flavoorbitalis* (Cameron), the major parasitoid of the pest predominantly appeared in the area during August and September. Predominant predators associated with the crop included several species of spiders (Araneae), coccinelids and grasshoppers. Crops established in March could escape from the damages of the pest.

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**212/B**

**Sucking pest spectrum of ratoon Brinjal in the mid country intermediate zone of Sri Lanka; a preliminary study**

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A study was carried out to find out the sucking pest spectrum of the brinjal ratoon crop variety Lenairi and to examine the diversity indices of the pests in the mid country intermediate zone of Sri Lanka during the period 2004/2005. Ratoon brinjal crop variety Lenairi after one month of pruning was selected for the study and was randomly sampled in weekly interval and insect counts were made. Representative samples were preserved for the identification.

Species richness was found to be 6 and presence of 6 sucking pests namely mites (Acarina), aphids (Homoptera), whiteflies (Homoptera), mealybugs (Homoptera), leafhoppers (Homoptera) and lace bugs (Heteroptera) were observed. The diversity index of these pest insects was very low that is 0.6085, indicating that the pest species in the ratoon brinjal eco system have dissimilar relative abundance that is of low diversity and few species were dominant. The Shannon evenness index (E) of 0.34 also supports this result. The relative abundance of aphids and mites were high during the study period with the mean of 35.06 and 34.45 respectively followed by the relative abundance of mealybugs, leafhoppers, lace bugs and whiteflies.

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**213/B**

**Effect of substrates on the growth and sporulation of *C. gloeosporioides* isolated from papaya (*Carica papaya* L.)**

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Anthraco-nose caused by *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. is the most serious disease that affects the ripened fruit, which hamper the commercial production wherever papaya is grown. Despite magnitude of economic losses resulting from this pathogen, few efforts have been made in understanding the cultural and morphological studies of the fungus specially in relation to papaya. It is therefore, important to study the existence of diverse pathogenic populations within a specific area to expedite implementation of control strategies. In view of the above, current study was undertaken to investigate the effect of different solid and liquid media on the growth and sporulation of seven isolates of *Colletotrichum gloeosporioides* of papaya. Czapek's dox agar (CDA), Sabouraud's agar (SA) Malt extract agar (MEA), Dextrose asparagine agar (DAA), Potato dextrose agar (PDA), Richard's agar (RA), Coon's agar (CA), Fruit extract agar (FEA) and Petiole extract agar (PEA) were used as nine different solid media, for this study. The broth cultures of the above media without adding agar were used as the liquid media to study growth and sporulation of those isolates. Observations on the mycelial growth, weight of the mycelium and the extent of sporulation were recorded at 7 days after the inoculation. Growth of different isolates on different media was not similar according to the study. Both PDA and Richard's agar found to be the best solid and liquid media for most of the tested isolates of *C. gloeosporioides* for artificial culturing. The pathogen under study sporulated better on Richard's agar and Sabouraud's agar and Richard's broth and Sabouraud's broth, respectively. According to the study, for most experimental studies with *C. gloeosporioides*, Richard's medium (solid or liquid) could be useful.

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**214/B**

### **Propagation studies on Jackfruit (*Artocarpus heterophyllu* L.)**

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Jackfruit (*Artocarpus heterophyllus*) belongs to family Moraceae. It is important fruit to the people of Sri Lanka and it is traditionally called "rice tree". The continuous seed propagation and heterogeneous nature has enriched the genetic diversity in the Jackfruit. However, with increased population pressure and use of land for more annual crop cultivation there has been progressive erosion of the diversity of Jackfruit. To produce true to type plants and perpetuate outstanding cultivars, asexual propagation is essential. Asexual propagation of Jack fruit has been studied and reported poor success in Sri Lanka. Therefore propagation studies were carried out through cleft grafting and inarching at Horticultural Crops research and development Institute (HORDI) Gannoruwa to find out a suitable method for multiplication.

For cleft grafting large seeds were selected and soaked in water for 24 hours. These seeds were sown in poly bags filled with soil, sand and compost to a ratio of 1:1:1. The seedling at different age types (15, 20, 25, 30, 35, and 40 days) was used as rootstock and 2 types of scion as varieties (Father long and Hirosa). Fifteen plants were used for each treatment and replicated 3 times. The grafted plants were covered with polythene bags and kept in a propagator. The rate of success was recorded 1½ months after grafting. It was significant (Average 80%) when the scion was grafted on to root stock of 20 -30 days old seedling. But the success was little varying with the varieties

Plants of 5 month old seedling were taken without damaging the root system for inarching. Extra roots were removed and dipped in water added with root hormone known as "rootone F". Then these were planted in poly bags filled with coir dust and tied. Then the top end of the stock was cut (20- 25 height) diagonally and inserted into the cut made on the scion tree. Fifty root stocks were used for

inarching. The bud union was tied with a polythene tape and left for 3 weeks. Then the cuts were subsequently made. Inarched plant was separated out two weeks after the 2<sup>nd</sup> cut. The plants were potted and kept in a propagator and success was recorded after 1½ months and the success rate was 40 %.

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**215/B**

### **Study on the effective storage method of cowpea (*Vigna unguiculata*) against storage pest**

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A laboratory study was conducted to find out a suitable storage method for cowpea against the storage insect *Callosobruchus maculatus* by comparing the effect of four treatments such as neem leaf powder (5g/100g of cowpea seeds), citrus leaf powder (5g/100g of cowpea seeds), rice husk ash (5g/100g of cowpea seeds) and exposure to sunlight continuously for six hours in a weekly interval for one month and the number of cowpea seeds with eyehole and number of adult emergence were assessed for two month. These parameters were compared with untreated control. The number of cowpea seeds with eyehole in all treatments (neem, ash, citrus and sundry) other than the control was significantly ( $p < 0.05$ ) reduced. Number of adult emergence was significantly reduced when neem, ash and citrus were used. However, it was found out that the neem, ash and citrus had higher efficiency in reducing the number of seeds infested with *Callosobruchus maculatus* and the emergence of adults. Therefore, based on these results neem leaf, ash and citrus could be effectively used against *Callosobruchus maculatus* in cowpea than the seed exposed to sunlight.

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**216/B**

### **Development of technology to produce nutmeg (*Myristica fragrans* Houtt.) jelly using its pericarp**

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The nutmeg tree (*Myristica fragrans* Houtt.) produces two separate and distinct products; nutmeg and mace, which are about 30 % of the fresh fruit. The fleshy pericarp or the rind represents 70 % of fruit is discarded during processing of nutmeg as a by product. This can be used to produce jam, chutney, marmalade etc., as it contains a considerable amount of pectin, which is a natural substance. The direct major usage of spices are inclining towards value addition and gradually moving from primary processed products to more value-added products as they fetch more profits. Value added spice products are more popular in food sector over the primary processed products. The main aim of the study is to develop a new value-added product from the pericarp extraction of the nutmeg fruit for the ready to serve market and to create a market value for the nutmeg pericarp.

Nutmeg fruits of fully matured were selected and extraction was done by boiling 3.0 kg of cut pieces of rind or pericarp with 3.0 L of water for 30 minutes. The extract was filtered through a muslin cloth to remove the residues. Three sets of 800 mL, 780 mL and 760 mL extractions were prepared and labeled as treatment A, B and C. They were boiled with 745.0 g, 720.0 g, and 700.0 g of sugar respectively. To obtain the Brix value to 65 ° and the original set structure of the jelly, commercial grade pectin was added in different scales while maintaining the pH range at 3.1 - 3.3. As a preservative 20 mg of potassium meta-bi-sulfite (K<sub>2</sub>S<sub>2</sub>O<sub>5</sub>) was added to each set.

A sensory evaluation test was conducted to observe the consumer preferences for three treatments of nutmeg flavoured jelly with thirty-three members and data were analyzed using a ranking method. Overall preferences, as per the panel test were 43.17 % for the treatment A, 36.69 % for treatment B and 20.14 % for treatment C. The preference values for colour, sweetness, flavour and aroma, transparency and mouth feel softness were analyzed only for the treatment A. The overall preference values for the colour, sweetness, flavour and aroma, transparency and mouth feel softness were 54.54 %, 81.81 %, 60.60 %, 84.84 %, 78.78 % respectively. Developed recipe for the Jelly, treatment A was selected as the best out of three jelly samples tested to introduce as a new value added product and to conduct further studies.

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**217/B**

### **An approach to control nutmeg leaf fall disease by spraying fungicides**

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Nutmeg is one of the important export spice crop present in Sri Lanka. Leaf fall disease reported recently caused a considerable loss to the harvest by reducing a high percentage from the total production. Disease is caused by an imperfect fungi, *Colletotrichum* species. Symptoms at the initial stage can be seen on tender leaves as tiny black to brown spots. With the leaf growth, spots enlarged up to 1-2mm in size and cause immature leaf fall resulting withered twigs. Finally, seriously affected twigs can be seen as dried sticks.

This study was carried out to find out a rapid solution to control this wide spreading disease. Two steps were included in the experiment. In the first experiment, four fungicides were screened in the laboratory with a control. *Colletotrichum* sp. (Causative organism) was cultured on PDA with different concentrations of fungicides. Dithane M® 45, Ridomil®, Folicur® and 1% Bordeaux mixture were used as fungicides with 3 replicates. Dithane M 45® showed the best controlling ability against the fungus.

In the field trial above mentioned fungicides were sprayed directly to the foliage of the infected trees in following concentrations. Nine grams of Dithane M 45®, sixteen grams of Ridomil®, five milliliter of Folicur® each were dissolved separately in ten Liter of water and 10 liter of 1% Bordeaux mixture. Each application was carried out with three replicates at two week intervals and the data was collected as percentage canopy loss of the infected trees. From the results Dithane M 45® and Ridomil® showed a better canopy recovering ability of 28% and 25% respectively, in comparison to other two fungicides. In addition Dithane M 45® showed a rapid recovering ability against the disease. Based on the results, Dithane M 45® can be considered as a better fungicide for controlling nutmeg leaf fall disease. Fungicide application should be repeated at two week intervals during the flushing season until the newly formed tender leaves become matured.

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218/B

### Evaluation of six robusta coffee (*Coffea canephora* Pierre ) varieties

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Coffee belongs to genus *coffea*, which is a member of the family *Rubiaceae*. Two species of coffee are commercially cultivated, such as *Coffea arabica* L. (arabica coffee) and *Coffea canephora* Pierre (robusta coffee). This study was initiated to evaluate six important robusta coffee varieties such as Q36, Q96, IMY, CCI, S274 and GCR for the yield and adaptability to the mid country wet zone of Sri Lanka.

Six robusta coffee varieties were planted at the Export Agriculture Research Station, Matale in 1977. Randomized complete block (RCBD) design was used having six varieties as treatments with three replicates and 30 plants per plot. Plants were collar pruned in April 2001 to obtain even canopy structure. The trial was maintained using recommended general management practices recommended by the Department. The yield data were recorded during four years period.

According to the results, variety IMY performed well in 2003 (dry weight -1014.9 g plant<sup>-1</sup>), 2004 (1686.7 g plant<sup>-1</sup>) and 2005 (1814.4 g plant<sup>-1</sup>) compared to the other varieties. However, all the varieties performed well except Q 36 (801.3 g plant<sup>-1</sup>) and Q 96 (858.2 g plant<sup>-1</sup>) in year 2005. Therefore, it clearly indicates that the variety IMY performing better than the other varieties from the initial stage to the last yield collected. However, it shows some yield reduction in year 2006 (1100.7 g plant<sup>-1</sup>) which may be due to alternative bearing pattern. The estimated mean processed yield also shows the highest value (2120 kg ha<sup>-1</sup> yr<sup>-1</sup>) in the variety IMY. CCI and GCR are equally performing in every year. However, when compared the estimated dry yield, CCI (2075 kg ha<sup>-1</sup> yr<sup>-1</sup>) is better than GCR (1975 kg ha<sup>-1</sup> yr<sup>-1</sup>). Variety S274 was performing well in 2005 but in other three years, performances were poor. Varieties Q36 & Q96 gave lower yield in every year. Yield increment was observed until 2005 in all the varieties except Q36 & Q96. Yield reduction in year 2003 may be due to the effect of collar pruning and the yielding pattern from 2004 to 2006 can be described as the dimorphic yielding pattern in robusta coffee. Variety IMY & CCI have 3.83:1 & 4.26:1 fresh into dry parchment yield conversion rate respectively and Variety Q 36 shows the highest fresh: dry yield conversion rate (4.34:1).

Finally it can be concluded that Varieties IMY and CCI can be recommended as the high yielding robusta coffee varieties giving more than 2000 kg ha<sup>-1</sup> yr<sup>-1</sup> processed coffee yield for the mid country areas. Varieties GCR and S 274 also can be recommended & Varieties Q 96 and Q 36 could not be recommended for the similar agro-ecological conditions.

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219/B

**Evaluation of antioxidative properties of selected herbs – a preliminary study**

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An experiment was carried out to evaluate the antioxidative properties of selected herbs. Fresh rhizomes of ginger (*Zingiber officinale*), and turmeric (*Curcuma longa*), fresh cloves flower buds (*Caryophyllus aromaticus*), fresh and dried rhizomes of cinnamon sedge (*Acorus calamus*), dried castor seeds (*Ricinus communis*), fresh cinnamon bark (*Cinnamomum zeylanicum*), dried pathpadagam whole plant (*Mollugo cerviana*), dried margosa seeds (*Azadirachta indica*), fresh nutmeg whole fruit (*Myristica fragrens*) and fresh and dried khus- khus grass roots (*Vetiveria zizaniodes*) were selected for the study. Cleaned and crushed raw materials as well as their ethanol and steam extracts were evaluated. Thiobarbituric Acid (TBA) value was determined to quantify the extent of oxidation using lard as the substrate. Samples of lard were supplemented with herbal materials (1 g/10 ml) or their extracts (1 ml/10 ml) in triplicate and stored for 2 weeks at room temperature. Lard without supplements was kept as a control. TBA values of samples after 2 weeks were recorded to estimate the extent of oxidation during storage.

Table 1. Increases in TBA values of lard without (control) and with herbal additives (mean ± SD) after 2 weeks of storage

Treatment	Raw material	Steam extract	Alcohol extract
Lard alone (control)	-----	0.79 ± 0.194	-----
Turmeric	0.31 ± 0.061	0.11 ± 0.011	0.31 ± 0.011
Ginger	0.35 ± 0.035	0.22 ± 0.069	0.26 ± 0.034
Nutmeg	0.45 ± 0.075	0.11 ± 0.011	0.14 ± 0.02
Patpadagam	0.66 ± 0.02	0.33 ± 0.05	1.06 ± 0.117
Cinnamon	0.41 ± 0.064	2.02 ± 0.011	1.06 ± 0.121
Margosa	0.36 ± 0.034	0.21 ± 0.023	0.39 ± 0.023
Castor	0.19 ± 0.011	0.15 ± 0.011	0.16 ± 0.034
Cloves	0.34 ± 0.103	0.19 ± 0.011	0.47 ± 0.011
Khus-Khus Grass	0.71 ± 0.03	2.07 ± 0.011	0.87 ± 0.03
Cinnamon Sedge	0.28 ± 0.04	0.2 ± 0.02	0.33 ± 0.05

The initial TBA value of fresh and pure lard was 0.22. According to data presented in Table1, lard without additives has been oxidized during storage. Pathpadagam, cinnamon and khus khus grass have promoted oxidation while all the other herbs have reduced oxidation of lard at varying rates. Castor, turmeric, nutmeg, ginger and margosa found to contain good antioxidative properties. Steam and alcohol extracts of herbs seem to be more effective than their raw materials.

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220/B

**Design, fabrication and evaluation of flat bed type solar drying system for pepper drying**

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Drying of agricultural commodities is a critical problem for producers due to several reasons such as coincidence with rains during harvesting season etc. Black pepper (*Piper nigrum* L.) the major spice crop produce in Sri Lanka that is processed mainly for the export market, which is harvested in November to January and May to July during the period of *Maha* and *Yala* rains respectively and so, the growers face a serious problem for the production of high quality black pepper that eventually leads to low market prices. However, some growers and collectors rent paddy drying yards in the dry zone areas and dry their harvest during these seasons, where small and middle scale farmers cannot practice it due to high transport cost. Therefore, it was aim to design and fabricate a solar drying system with locally available materials targeting the small scale farmers.

The drying system was fabricated with two compartments; (a). the drying chamber and (b). the solar collector using locally available materials. Drying bed was made using a plastic mesh. Single phase electric blower was used to blow hot air from the solar collector to the drying chamber. Dryer was evaluated for black pepper to observe its performances while a sample was allowed to sun drying as a control. Samples were collected at regular intervals to determine the moisture content. Temperature of the inlet of the drying chamber, surface temperature of drying bed and ambient temperature were measured at regular intervals by using thermocouple thermometer.

The moisture content decreased to 12 % within 15 hours in the solar dryer where as sun drying needed 18 hours. The temperature of the drying chamber varied within the range of 40°C to 64°C. Moisture variations of pepper in the drying bed were almost same in the areas of inlet, middle and the outlet. The final moisture content, 12 – 14% of black pepper was reached within the same drying period every where in the bed. It was found that the heated air distribution of the chamber is satisfactory with even drying. The Labour use for drying was observed to be very much less. The quantity used per batch is low and can be handled by one labourer easily. The moisture content of the fresh pepper was reduced to 12 % within 15 hours and cost of production of the final product is Rs. 8.66 for drying fresh kg and Rs. 24.75 for dry kg. Therefore the flat bed type solar drying system was found to be a satisfactory fabrication for the processing of small scale harvests of the farmers. Further modifications and evaluations are needed before introduce the drying system to the farmers.

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**221/B**

**Rooting and acclimatization of *in vitro* propagated *Celastrus paniculatus* Willd. (Duhudu)**

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*Celastrus paniculatus* Willd. (Family Celastraceae) [ Duhudu (S)] is an important medicinal plant listed as a threatened plant in Red data list published by IUCN in 1999. *In vitro* shoot multiplication was successful and the objective of this study was to determine a suitable growth regulator combination for *in vitro* root initiation and acclimatization of micropropagated plants.

*In vitro* propagated shoots obtained from nodal segment explants grown in Murashige and Skoog medium supplemented with 5.0 µM BAP and 0.5 µM IAA for 10 weeks were used for root initiation. Different concentrations of IAA and IBA were used in MS basal medium in order to induce rooting and

cultures were incubated under 16 h light at  $25 \pm 1$  ° C. Number of roots per shoot was measured weekly over a period of eight weeks. Mean root length was measured at sixth week before transferring into sterile sand for acclimatization. Plants were acclimatized in a humid chamber for three weeks and then different potting mixtures (i.e. Top soil : Coir dust : Compost, (1:1:1), River sand : Coir dust : Compost (1:1:1), River sand : Top soil : Compost (1:1:1) and River sand : Top soil : Coir dust (1:1:1) ) were used to determine the survival percentage of plants. Plant height, number of leaves and number of branches were recorded over a period of six months.

Root initiation was observed after 15 days in MS medium supplemented with 5.6  $\mu$ M IAA and 9.6  $\mu$ M IBA ( $5.6 \pm 0.81$  roots per shoot and 73.3 % rooting). All the other media tested showed lower percentage of rooting and time taken for root initiation was longer. Best potting mixture for growth of acclimatized plants was a mixture of River sand: Top soil: Compost (1:1:1) (80 % survival). Mean height of the plants and mean number of leaves per plant increased in a constant manner over the period of six months and plants were morphologically similar to natural plants.

Since growth conditions *in vitro* are different from those under natural conditions, it is possible to show deviations in anatomy, morphology and especially in chemical composition in micropropagated plants. Therefore further studies will be carried out in order to determine the chemical composition and anatomical structure of *in vitro* propagated plants.

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**222/B**

### **Use of herbal waste as a major ingredient in compost production**

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Composting is the method that recycles organic matter in its environment. Compost is manufactured by decomposing a mixture of crop residues, manures and wastes. The compost usually provides all the major plant nutrients, NPK and wide range of micronutrients, where as inorganic fertilizers provide only one or two nutrients to the soil. Using compost in organic farming enhances soil structure, physical properties and assists crops to withstand the effects of water scarcity. Strategy of using compost is that it has definite social, economic and agricultural benefits. Thus wide range of materials can be used in preparing compost. Waste produce through herbal drug preparation is rich in nutrients. Reuse these waste in an environment friendly manner is an advantage. Therefore this preliminary research trial was carried out to produce high quality compost, which could be used to increase soil fertility level.

In present trial three different ratios of herbal waste, cow dung and lime were used as three mixtures. They were mixed thoroughly and each mixture was heap up to 0.80 m height with a basal area of 2.0 m<sup>2</sup>. They were covered and regular watering was done to avoid drying. Turning of materials were done after second and fifth week to mix them well.

After three months fresh weight, some physical characters (texture, colour and smell) and major plant nutrients (N, P, K) and organic matter percentages were analyzed and pH was measured.

All three mixtures were highly friable and smelled earthy at the time of collection. Average pH value of mixtures was 7.3 which is favorable for plants. According to results the mixture with waste, cow dung and lime in ratio of 4:5:1 was the best mixture with 1.197 % N, 0.018 % P and 1.543 % K, 13.4 % organic carbon and 23.09% organic matter. All the mixtures are rich in N P K content and other physical properties. Next step of this trial would be apply them into field plants and find out its suitability for plants and compare with recommended fertilizers.

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## 223/B

### Isolation and characterization of *Bacillus thuringiensis* strains from two selected sites in Gampola and Nochchiyagama

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The protein toxins produced by *Bacillus thuringiensis* are the most widely used natural insecticides in vector control and for pest control in agriculture. *Bacillus thuringiensis* strains were isolated from surface and sub-surface soil samples collected from Gampola and Nochchiyagama and compared with a control soil sample from the Institute of Fundamental Studies premises in Kandy. *Bacillus thuringiensis* was isolated by 0.25M sodium acetate selection method. Isolated *Bacillus thuringiensis* was grown on Luria Bertani agar medium and stained by Gram staining procedures. Eighty isolates of *Bacillus thuringiensis* were identified by Coomassie Blue staining procedure and characterized based on colony morphology, crystal shape and plasmid profile.

Results revealed that sub-surface samples had more *Bacillus thuringiensis* counts than surface soils. This study also showed that *Bacillus thuringiensis* was highly abundant in soils contaminated with animal wastes. All the isolates formed 'pan cake' like circular colonies with smooth or serrate margins with varying diameter. 91.25% of isolates were found to have rod shape crystals, 7.5% were spherical shape and only one isolate had rhomboidal shape. Isolates from Gampola soil had four different *Bacillus thuringiensis* strains and of these isolates, 82.14% was *Bacillus thuringiensis israelensis*. There were nine different *Bacillus thuringiensis* strains in the isolates from Nochchiyagama sample and 51.21% of these were *Bacillus thuringiensis israelensis*. However, control sample collected from Institute of Fundamental Studies premises also had two different *Bacillus thuringiensis* strains of which 36.36% were *Bacillus thuringiensis israelensis*. There was large number of different *Bacillus thuringiensis* strains available in dry zone soils than in wet zone.

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## 224/B

### Changes in profitability and resource use in paddy farming in Sri Lanka in the recent past and their implications

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Paddy sector occupies a predominant position in Sri Lanka's economy. In the more recent years, paddy cultivation has been affected by many forces of change including economic, social, institutional, trade. This study is primarily designed to undertake a closer look at the changes emerging in the paddy cultivation system with a special focus on its input use, cost structure and profits. The study is based on secondary data relating to Maha cultivation seasons during the 1995-2003 period. The analysis covers both dry zone and wet zone districts: Anuradhapura, Hambantota, Polonnaruwa, and Kalutara.

Overall, the analysis show that the input-mix used in paddy cultivation has not undergone large changes overtime. However, the total labor input has declined from an average of 104 workdays/ha in 1995 to 88 workdays/ha in 2003. The study shows that the paddy cultivation is currently facing a major labour shortage, due mainly to its less attractiveness as a source of employment. This trend is more visible in paddy grown under major irrigation schemes, where mechanization is increasingly being adopted as a means of substituting hired labour. During 1995- 2003 period, wages have increased in 8.3% per year. The fertilizer application, which accounts for about 25% of the total cost, has remained at high levels (around 420 Kg/ha) in all areas. The high levels of fertilizer use are a direct result of the operation of the subsidy programme. The production system is also showing a continuous escalation of costs, averaging to 8.4% per annum in all districts - ranging from 12.5% in Kalutara to 4.2% in Anuradhapura. Labour input, which account for nearly half the total production cost, has contributed to the largest share of increased production costs. The analysis shows that the cash needs for paddy cultivation is increasingly becoming bigger, 28,000 Rs. /ha or 80% of the total. This implies a growing need for providing more cash inputs into paddy farming.

The average gross returns from paddy farming in the major paddy growing districts averages to 18, 000 Rs. /ha with net returns of about 11,000 Rs./ha (31% of the total production cost). The study identifies the fluctuating market prices during harvesting times as the most critical problem affecting the producer. Although the cost of production is increasing over time the net returns are not showing commensurate increases.

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**225/B**

### **Identification of bacterial diseases in imported seed potatoes**

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Due to insufficiency of local seed potato production, every year a considerable amount is imported from other countries. Through imported seed potatoes, there is a chance of introducing pests and diseases to the country. To prevent entry of quarantine pests and other diseases, suitable safeguards need to be taken. Thus, there is a necessity to identify different types of bacterial diseases in imported seed tubers and recognize the quarantine pathogens in potato tubers with reference to bacteria. Visual observation of diseases was done at the port of entry (sea port) during the plant quarantine inspection of imported seed potatoes. Laboratory analysis of representative samples was done for further identification of pathogens, by observing cultural characteristics and adopting biochemical tests. Two hundred and twenty nine samples were tested during the period of September 2005 to March 2006. Investigations revealed that the diseases like common scab (*Streptomyces scabies*), netted scab (*Streptomyces reticulisacabies*) and soft rot (*Erwinia carotovora* pv. *carotovora*, *Erwinia carotovora* pv. *atroseptica* and *Erwinia chrysanthemi*) were recorded within the limits of health

standards prescribed by the Department of Agriculture. During this period bacterial wilt (*Ralstonia solanacearum*) and ring rot (*Clavibacter michignensis*) were not detected in tested samples.

Key words: Seed potato, Quarantine diseases, health standards

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**226/B**

### **Weed seed contaminations of imported onion (*Allium cepa*) seed lots**

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In Sri Lanka, growing of B'onion (*Allium cepa*) is done by using the imported onion seeds mainly from India. This study was done at the National Plant Quarantine Service, Katunayake to identify weed seed contaminations of B'onion seed consignments imported into Sri Lanka from India in year 2006. During the year 2006, twenty three samples of B'onion seed consignments were checked for weed seeds and all samples were contaminated with weed seeds. Among the weed seeds identified, *Chenopodium album*, *Covolvulus arvensis*, *Euphorbia dentata*, *E.maculata*, *Astragalus* sp. and *Argemone platyceras* have not been recorded in Sri Lanka. *Parthenium hysterophorus*, which have been under official control in Sri Lanka. *Chenopodium album*, *Convolvulus arvensis* and *Dactyloctenium aegyptium* are in the list of world's worst weeds. Sri Lanka considered *Cuscuta* sp., *Parthenium hysterophorus* and *Opuntia* sp. as quarantine important weed species. Although, *Achyranthes*, *Amaranthus*, *Brassica*, *Ipomoea*, *Phyllanthus*, *Trifolium*, *Lolium*, *Echinochloa*, *Setaria* and *Panicum* species have been reported in Sri Lanka, *Amaranthus*, *Echinochloa*, *Setaria* and *Panicum* species are highly competitive, aggressive weeds. Control of such weeds is very difficult and highly expensive. According to the tetra solium test, all the weed seeds detected were viable. As these weeds have a potential of establishment in our country with planting of onion seeds, proper pre-entry and post-entry safeguard measures should be implemented to prevent the entry and establishment of unwanted alien weed species.

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**227/B**

### **Effect of kieserite and dolomite as a Mg source in black pepper**

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Black pepper (*Piper nigrum* L.) is the second most important perennial spice crop grown in Sri Lanka. Though the crop is extensively grown at wet and intermediate zones in Sri Lanka, national average yield is around 400kg/ha/yr despite of the potential yield under good management conditions over 1500 kg. Poor cultural practices adopted by most of the growers is the main reason for that and due to high cost of fertilizer, soil nutrient management is extremely poor. Out of the cost of production, fertilizer cost is equal to about 30% and as a result most growers applied either inadequate or imbalance fertilizer, which leads to low yields. This study was carried out to find out the possibility of

substitute low cost, locally available dolomite for imported kieserite as a source of Mg fertilizer for pepper. Experiment was conducted at Export agricultural main research station at Matale, soil type is Typic Rhodustal (Matale series ) under WM-3b agro ecological region. Dolomite and kieserite are tested as two levels, as the department recommendation (28g Mgo/plant/yr and half of that) with no Mg as a control and all the plots received the recommended amounts of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (196g, 154g, 196g/plant/yr). Treatment were arranged in RCBD design with 3 replicates. Treatments were applied as two split applications per year. Pepper yield data collected for four years period. It indicated that yield was significantly improved by applying mg compared to the control at P≤0.005. However no significant difference could be found among the treatment received different rates of Mg The highest mean dry pepper yield of 616kg/ha/yr associated with 14g MgO/plant/yr as dolomite while control treatment produced only 360kg/ha/yr. Application of 28g MgO/plant/yr as kieserite gave second highest 550kg/ha/yr. The results suggest that dolomite can be effectively used as a source of MgO instead of high cost kieserite in black pepper.

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## 228/B

### **Evaluation of S9 arabica coffee (*Coffea arabica* L.) progeny for the yield in mid country of Sri Lanka**

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Coffee is a perennial seed crop; cultivated as a beverage Export Agricultural crop in Sri Lanka. Two species of coffee are commercially cultivated, namely *Coffea arabica* L. (Arabica coffee) and *Coffea canephora* Pierre (Robusta coffee) but, arabica coffee is the most important species and it occupies 80% of the world market. Among those arabica varieties selection 9 (S9) which is a selection obtained from the hybrid between Hibrido de Timor (HDT) and x Tafarikela is one of the very important selections introduced from India. This variety thrives well in high altitude areas above 600 m ASL. However, it gives considerable yield in the mid country wet zone ecological conditions even below the 600 m ASL. Cup quality of S9 coffee is very much higher when compared to the other arabica varieties. It has high resistance to the coffee rust disease. Therefore, it is important to evaluate a progeny from the S9 variety and select the high yielding plants for crop improvement programs.

A progeny from one of the best mother plants was field established in complete randomized design. All the plants were collar pruned in 1998 to obtain even canopy structure and maintained using recommended management practices by the Department. Initial growth data including height, girth at 7.5 cm height from the base, canopy diameter and the number of plagiotropic branches were recorded in four months interval. Yield data were recorded during six years period.

It takes approximately three years to give considerable yield after collar pruning. Yield data clearly shows that the alternative yielding pattern. Therefore, the mean yield is comparatively low. The best yielding two plants (S4/2 and S4/5) were selected considering the cumulative fresh yield of the plants where the estimated dry yield over 2000 kg ha<sup>-1</sup>yr<sup>-1</sup>. However, plant S 4-2 shows the dry yield of 2.9 kg plant<sup>-1</sup> (8900 kg ha<sup>-1</sup>) in 2004. Those two plants have shown promising height (150 cm) and girth (21 mm) at 15 months age. Plant S 4-2 shows the highest canopy spread (110 cm) and number of plagiotropic branches (23 plant<sup>-1</sup>) whereas plant S 4-5 shows the highest yield (185 g branch<sup>-1</sup>) in 2004. Those characters can be used for future hybridization programmes.

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229/B

### **Intensification of upland crop production in Anuradhapura district through agro- climatic approach**

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As water is a major limiting factor that affects for upland crop production (Vegetables) in Anuradhapura district, a study was conducted to find the optimum cropping calendar that require least amount of irrigation water. The analysis was carried out using daily rainfall data for 35 years (1971 – 2005) at different rain gauge stations, namely Anuradhapura, Mahailuppallama, Nochchiyagama, Kalawewa, Elayapaththuwa, Padaviya and Vavuniya. Pan evaporation data at Mahailuppallama Meteorological Station was also used for the analysis.

Hargreaves Moisture Availability Index (MAI) and 10 mm weekly rainfall at 75% probability level were used to find rainfall onset in each station. Probability level was reduced in above mentioned methods, as wet weeks couldn't be identified during *yala* season when the probability level exceeds 75%. Based on forward accumulation of rainfall method, the date, which accumulates 100 mm of rainfall after a dry period, was taken as the crop commencement date for upland crops. A field survey was conducted to find the existing crop establishment time. The irrigation requirement for upland crops, when they are established on the weeks, which were found by the above mentioned methods and by field survey was determined using CROPWAT software program.

Hargreaves MAI at 60% probability dependable rainfall and 10 mm weekly rainfall at 55% probability was identified as the suitable probability levels for rainfall onset identification. The crop establishment date found by 10 mm weekly rainfall and MAI method recorded the least irrigation requirement for upland crops compared to forward accumulation and farmer practiced methods. The crop establishment week which reports the least irrigation requirement was selected as the optimum crop establishment time for both *yala* and *maha* seasons. Optimum crop commencement time and irrigation requirements for upland crops was 14<sup>th</sup> week, 241.3 – 306.4 mm and 37<sup>th</sup> – 43<sup>rd</sup> week, 0.0 – 38.4 mm for *yala* and *maha* seasons respectively. 37% and 82% of irrigation water could be saved in *yala* and *maha* seasons respectively for upland crops, when crops are established on optimum planting time compared to existing crop establishment time.

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230/B

### **Behaviour of tethered cattle in a coconut based integrated system**

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Behaviour of tethered crossbred heifers, grazing natural herbage under coconut was studied during three consecutive poya days for 72 hours continuously. Drinking water was available *ad-libitum* for all heifers.

When considering the total time budget spent on each activity, grazing became dominant of all activities spending 29.83 % (615.11 min) of total time period. Rumination (533.78 min), lying (525.72 min) and resting (282.89 min) became the next most prominent activities from the total time budget spending 28.88 %, 25.49 % and 13.72 %, respectively. Grazing was more prominent during the day time (range 324 to 581 min) than during the night (50 to 186 min) and vice versa was observed with rumination (132.17 in day versus 400.83 in night), lying (116 in day versus 445.33 in night) and resting (90.3 in day versus 184.17 in night). During the whole study period heifers urinated 6 times and defecated 9 times respectively.

Eructation has become the activity, which accounts for the lowest time duration (0.67 min, 0.033 %) from the total time budget. It was occurred mainly during the day time.

Significant ( $P < 0.01$ ) positive correlations were observed between the frequencies of walking and grazing ( $r = 0.956$ ), grazing and rumination ( $r = 0.812$ ), licking and scratching ( $r = 0.969$ ), drinking and grazing ( $r = 0.961$ ) and lying and rumination ( $P < 0.05$ ) ( $r = 0.856$ ).

Although not significant, heifers in supplemented treatment spent more time for resting, rumination, lying, licking and scratching. In contrast grazing of upper woody species layer and the lower layer, and vocalization were prominent with heifers in un-supplemented treatment.

It is concluded that, tethered cattle spend most of their time for grazing during the day time, followed by rumination, lying and resting during the night time. While other parameters such as drinking water, urination, defecation were not significant, there were significant correlations between frequencies of walking and grazing, grazing and rumination, lying and rumination, grazing and drinking water *etc.* Although not significant animals of the supplemented treatment spent more time on resting, rumination, licking, scratching and lying when compared with the un-supplemented animals. This concludes that supplementation plays a major role in suppressing the stress in tethered cattle.

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**231/B**

### **Efficacy of some selected botanical pesticides to control major paddy pests**

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Insect pest attack is one of the major biotic factor hampering the paddy production in the world including Sri Lanka. A study was carried out to find out the effect of some selected botanical pesticides on controlling major pests in paddy. The organic pesticides used in this experiment were OK (commercial preparation of neem), Garlic (50g)-neem oil (20g) and soap (5g) water (1 liter) mixture, Tobacco leaf extract (100g/1liter water) and an inorganic pesticide chloropyrifos (400 g / l EC). Pest number for BPH and paddy bug and number of symptoms for stem borer and leaf folder were counted continuously at 3<sup>rd</sup> and 9<sup>th</sup> day after spraying the chemicals. It was found that there was a significant reduction of pest population among treatments. Commercial preparation of neem (OK), Tobacco extract and Chloropyrifos significantly controlled leaf folder attack and reduced the population of Brown plant hopper and paddy bug. Tobacco extract and chloropyrifos reduced the attack of Yellow stem borer than garlic-neem oil- soap water extract application and similar reduction pattern was also observed in controlling BPH population. Tobacco extract reduced the paddy bug population in the panicle. It is concluded from the experiment that Tobbaco extract and O.K performed well and required frequent application. The garlic neem oil extract control common major pest and could not persist for longer time as recorded in the treatments of tobacco and O.K.

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**232/B**

**A Study on seed paddy production and supply of Sainthamaruthu-Karithevu seed Producers Association in Amparai district of Sri Lanka**

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The demand for rice is continuously increasing in Asian countries. An increased production of rice is possible by using good quality seeds with integration of other management practices. This survey study was conducted from members of Sainthamaruthu-Karithevu Seed Producers Association, which produces and supplies seed paddy in the respective divisional secretariat area of Amparai district. A survey method was employed to collect the data using structured questionnaire among registered farmers in this association. This study showed that almost all seed producing farmers produced the seed paddy variety Bg 94-1. The other seed paddy varieties produced by this association were Bg 358, Bg 357, Bg 352, Bg 403 and Bg 300. The registered lands extend 83 acres contributed 12 percent of private seed producing area in Amparai district. Nearly half of the farmers (50 %) have land extent less than 3 acres. Among the production practices, 80% of farmers used recommended inorganic fertilizer. The low land farmers have applied organic matter such as straw, cow dung, compost and poultry litter. Straw was the dominant freely available organic matter, which has been applied by 70 % of farmers. All farmers in the association produced seed paddy in *yala* season and 10 % of farmers do not cultivate in *maha* season because of flooding. The Department of Agriculture extended their support in supplying registered and certified seeds, technical advice, supervision and conducting training programme for seed paddy producers in this association. Fifty percent of farmers have more than five years of experience in seed paddy production.

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**233/B**

**Micro propagation of amukkara (*Withania somnifera*) through nodal cuttings**

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*Withania somnifera* of family Solanaceae is commonly known as Amukkara, Ashwaganda or Winter Cherry is an important perennial medicinal herb with long tapering roots. The roots are widely used in ayurvedic medicine. To meet our annual requirement of 42,000 kg, importation from India by spending Rs.2 million is necessary (IUCN, 2005). Development of an *in vitro* method for mass production of this valuable species would substantially reduce the import cost and generate employment opportunities. This study was conducted to develop an *in vitro* protocol for mass production of *W. somnifera*.

Experiments were designed using a Complete Randomized Design with twenty replicates per treatment, Murashige and Skoog (MS) medium with different combinations of Benzene Amino Purine (BAP) and Naphthalene Acetic Acid (NAA) were tested with two levels of sucrose (30 g/l and 40 g/l)

both in liquid and solid forms for shoot proliferation. Nodal cuttings detached from *in vitro* derived seedlings were used as explants. Number of shoots per explant and average height per shoot per explant were recorded at two-week intervals. After two months, proliferated shoots were separated and cultured on quarter, half and full strength MS media where the effect of Indol Butyric Acid (IBA) and Napthaline Acetic Acid (NAA) on root initiation was evaluated in addition. Number of roots produced, branching habit of roots and average length of a root were recorded at two week intervals. Rooted plantlets were transferred to potting media containing cow dung, sand and coir dust in different combinations and growth performances were recorded at two week intervals.

Liquid MS medium containing 1.0 mg/l BAP with 40g/l sucrose level gave maximum number of shoots per plant (40) with highest average height (2.6 cm) after two months. Two weeks after transferring to rooting media, quarter, half and full strength MS media with 1.0 mg/l IBA produced roots. After a month full strength MS with IBA showed the maximum average length per root and half strength MS with IBA resulted in maximum number of roots (10) where full, half and quarter strength MS with IBA produced branches in roots while media with NAA resulted in calli at shoot ends. During the acclimatization, more than two weeks in a humid chamber, produced elongated shoots. Sand: cow dung 1: 1 ratio is the best potting medium to get branched plants with healthy leaves.

*W. somnifera* can be successfully *in vitro* propagated through nodal cuttings and after a chemical analysis the well-acclimatized plants can be used for large-scale production of active ingredients for medicinal purposes.

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**234/B**

### **The resurgence of the pests due to the insecticide control of *Leucinodes orbonalis* (brinjal shoot and fruit borer-BSFB)**

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In order to prevent yield losses by pests, resurgence state and sources of them, should be identified and properly managed. Resurgence can be the dramatic population increase of either the same pest or some other potential pest. Variations in each pest population, for selected insecticides through questionnaire survey were compared with the untreated control, using Statistical Analysis System considering the factors, treatments (acetamiprid, carbofuran, deltamethrin, imidacloprid, chlorpyrifos and control without any insecticides and spraying of distilled water in the same amount of insecticide spraying), and before/after spraying. Resurgence was evaluated with the following formula for each species of pests found in the due of study.

$$\text{Resurgence} = \left( \frac{TS}{CS} \times \frac{CF}{TF} - 1 \right) \times 100 \quad \text{where,}$$

*TS* -Damage in treated pots subsequent count.

*CS* -Damage in control pots subsequent count.

*TF* -Damage in treated pots first count.

*CF* -Damage in control pots first count.

Populations of flies and thrips were insignificantly ( $P > 0.05$ ) varying among treatments including control, while having zero possibility to resurgence. Though whiteflies and leaf hoppers are infesting the plants, their small population promised the chances of resurgence were very much poor. Aphid

population was significantly ( $P < 0.05$ ) high in control plants followed by carbofuran than other treatments. Mealybugs were higher in deltamethrin and showed mild resurgence against deltamethrin. Red spider mites were resurged tremendously in acetamiprid followed by imidacloprid. Thus, in Batticaloa region aphids have potential to resurge under favourable weather, while mealybugs resurged mildly to deltamethrin and red spider mites have highest efficacy to resurge against acetamiprid and imidacloprid.

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**235/B**

### **Effectiveness, suitability and financial viability of combine harvester balkar in Ampara district**

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The study attempted to analyze the impact of using Balkar type combine harvesters, which is the most predominant combine harvester in this region for harvesting paddy on timeliness, harvesting cost, and labour use and evaluate effectiveness, suitability and financial viability of combine harvester in Ampara District. The major reason given for the use of combine harvester was severe shortage of labour during the peak season. The primary data needed to this study were gathered through a survey from 61 farmers and 62 owners of combine harvester. A descriptive evaluation and analysis were carried out to identify the objectives. The analysis of Variance (ANOVA) was used to find out the suitability, effectiveness and the Net Present Value (NPV) and Internal Rate of Return (IRR) were used to analysis the financial viability of the combine harvester. In addition to these techniques the partial budgeting was also carried out to compare the cost reduction in harvesting by combine harvester. The results shows combine harvester ensures rapid harvesting, reduces harvesting cost, minimize the labour requirement, and raises the farmer's income as well as machine owner's profit. The combine harvester replaced the labour by 75 to 85 %, reduced the harvesting cost by 50%. The results from the machine owner's survey indicated that the combine harvester was financially viable for the owners, and it was proved by the positive NPV and higher IRR when compared to opportunity cost of capital of combine harvester and the results also indicated the initial investment is an important factor while deciding the financial viability. The negative aspects of using combine harvesters were also reported as displacement of labourers, low quality paddy, climatic and soil constrains for the tyre type harvesters, non availability of local technical supports and the difficulties in fixing charges due to competitions. However it could be shows that the prospects for using combine harvesters for harvesting paddy is becoming popular in the Ampara district. With proper technical support, practical demonstration and appropriate training program profit of the farmers as well as machine owners can be increased.

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**236/B**

### **A preliminary biochemical study on germinated coconuts**

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Coconut (*Cocos nucifera*) is the major source of edible oil and fats. Quality of coconut-based products is mainly depending on the quality of kernel used to process those products. While processing commercial coconut-based products invariably include the kernel from germinated coconut at various germinating stages. Hence the study was carried out to find the chemical composition of coconut kernel during germination, oil and desiccated coconut produced from germinated coconut (using D×T and T×T varieties) at four different stages of germination (base on size of the shoot).

Chemical analysis of kernel with progress of germination showed that the moisture content decreased from 50% to 41.7%. Ash content remains constant around 1.0 - 1.3% while fat content increased from 30% to 41.3%. Protein content showed decreasing trend from 6.5% to 4.9% with germination. Crude fibre content of kernel decreased from 4.5% to 2.7%. Sugar content showed an increasing trend in early germination stages and decreased in later stages. Higher values were observed in D×T variety (4.2-2.7%) than T×T (1.52-0.9%).

Quality of oil from each germination stage was determined and found increasing trend in oil moisture content from 0.5% to 1.06%. Acid value increased from 0.3 to 0.4 and Iodine value varies around 8.0 – 8.7. Saponification value decreased from 280 to 259 with germination. Peroxide value was not in detectable level. Fatty acid profile at each germination stage was similar with normal oil showing 47-50% Lauric acid. Moisture content of desiccated coconut varied around 1.4 – 1.7%. Fat content increased from 59.6% to 64.5% and Acid value increased from 0.6 to 0.8 in desiccated coconut with the progress of germination.

Desiccated coconut and oil produced from germinated coconut kernel were not good for edible purposes as they were not attained the quality requirements by set Sri Lanka Standard Institute and Asian Pacific Coconut Community.

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**237/B**

### **Comparative studies on growth, yield and chemical composition of *Withania somnifera* (amukkara) and *Ruellia tuberosa* (local amukkara)**

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Amukkara (*Withania somnifera*) (Solanaceae) is one of the major imported species used in Ayurvedic system of medicine for the cure the variety of diseases and disorders. Most of the Ayurvedic physicians use *Ruellia tuberosa* (Local Amukkara) (Acanthaceae) as an alternative for imported Amukkara (*Withania somnifera*). An experiment was carried out in Medicinal plant garden at Gamudawa site, University of Ruhuna, Kamburupitiya to compare growth and yield of these two species. For each species sixty-five pots were used. These pots were arranged in a Completely Randomized Design with five replicates. Seeds of these two species were used as planting material and maintain one plant per pot. Data on growth parameters (plant height, number of branches,

number of leaves and leaf area) and yield parameters (root length, root dry weight and root volume) were collected. Data were analyzed using ANOVA with Statistical Analysis System (SAS) and means were separated using Duncans' Multiple Range Test (DMRT). Root samples were analysed for chemical ingredients at Industrial Technology Institute by using High Performance Liquid Chromatography (HPLC). All the growth and yield parameters were higher in *Ruellia tuberosa* than *Withania somnifera*. Chemical analysis showed that two key ingredients (Withanoloid and Withaferine A) are available in both species, but amount present in *Ruellia tuberosa* (1.1 %, w/w, 0.014%, w/w) is little less than *Withania somnifera* ( 1.54%, w/w, 0.015%,w/w ) respectively. Higher growth and yield were recorded in *Ruellia tuberosa* compared to *Withania somnifera*. Due to same active ingredients and well adaptability to the environment, *Ruellia tuberosa* can be cultivated as an alternative for *Withania somnifera*. This saves foreign exchange and ability to utilize local resources in better way.

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**238/B**

**Productivity improvement of foliage plant *dracaena sanderiana* (Ribbon Dracaena) variety "White"**

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In Sri Lanka, there are large scale *Dracaena sanderiana* plantations but with low productivity mostly due to poor soil conditions. With the objective of increasing the productivity of these plantations, three treatments were applied to selected four years old *Dracaena sanderiana* variety 'White' plantation at Tropical Foliage Private Limited, Badalgama. Treatments were arranged into split-split plot design, with four replicates.

Main factor - Forking of soil.

Sub factor - Application of coir dust and cow dung mixture.

Sub-sub factor- Fertilizer application (Urea based mixture, Ammonia based mixture and two slow release fertilizer types which differ in quality of the outer coat)

Recording number of cuttings per each sub-sub plot and rejection percentage of cuttings at monthly intervals measured the increment of productivity. Soil pH, soil moisture content and bulk density were recorded to measure the changes in soil conditions. Analysis of data was performed by using Statistical Analytical Software (SAS) package.

Results revealed that forking, application of coir dust and cow dung mixture and four fertilizer types had a significant effect on number of cuttings ( $P \leq 0.05$ ), but not on the quality of cuttings. Ammonia based fertilizer mixture had the highest average yield (0.037 cuttings/ stem) followed by Urea based mixture (0.03 cuttings/ stem). When considering the soil pH values, Ammonia based mixture showed higher acidity (5 pH) than others. Cow dung and coir dust mixture had a buffering effect on soil pH. Forking and application of coir dust and cow dung mixture, significantly improved the bulk density and moisture content of the soil ( $P \leq 0.05$ ).

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**239/B**

## **Suitability of Pan estimated PET and $ET_0$ by Modified Penman method to DL<sub>1b</sub> agro-ecological zone in Sri Lanka**

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A reasonable estimate of potential evapotranspiration of a particular agro ecological environment is a prerequisite for efficient management of irrigation water. In Sri Lanka, estimation of crop water requirements and irrigation scheduling are done based on estimates of potential evapotranspiration values based on pan method.

The FAO Penman-Monteith method is recommended as the sole standard method to estimate reference evapotranspiration ( $ET_0$ ). It is a method with strong likelihood of correctly predicting  $ET_0$  in a wide range of locations and climates. Monthly average maximum temperatures, minimum temperatures, relative humidity, bright sunshine hours and wind velocity values collected during the period of 1976-2004, at Maha Illuppallama meteorological station was used for a study where  $ET_0$  was calculated using the Penman Monteith equation using the Cropwat 4 windows Ver 4.3 software. The Penman Monteith ( $ET_0$ ) values were compared with potential evapotranspiration (PET) values and modified Penman  $ET_0$  values of above meteorological station to check the suitability of these two methods for DL<sub>1b</sub>.

The calculated reference evapotranspiration values by all three methods show the similar pattern throughout the year. Three methods have quantitative difference of  $ET_0$  values. However none of the methods showed a significant difference on reference evapotranspiration values under the experiment. The Penman-Monteith approach shows relatively accurate and consistent performance. There is lower estimation of  $ET_0$  values in pan evaporation method because it influenced by pan surrounding, fetch, relative humidity, and wind speed. The modified Penman method shows the higher estimation that uses average recent data for about five years of its calculations. Reference evapotranspiration at Maha Illuppallama exhibits a temporal variability. The lowest  $ET_0$  values occur in December, while the highest  $ET_0$  in March according to three methods.

It is recommended to use Penman-Monteith  $ET_0$  values in any future works such as determining crop water requirement, irrigation scheduling, as input for yield modeling or any other agricultural planning activity.

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### **240/B**

#### **N mineralization of soil as affected by different mixtures of vermicompost and coir dust**

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A mixture of vermicompost and coir dust sounds better performance than using them alone. The current study assessed the effect of different mixtures of vermicompost and coir dust on soil N mineralization under laboratory conditions.

Different percentages of vermicompost and coir dust were used in making four different mixtures [100 % vermicompost (T<sub>1</sub>), 75 % vermicompost: 25 % coir dust (T<sub>2</sub>), 50 % vermicompost: 50 % coir dust (T<sub>3</sub>), 25 % vermicompost: 75 % coir dust (T<sub>4</sub>)] and incorporated to the soil. The control consisted soil without vermicompost or coir dust. NH<sub>4</sub><sup>+</sup>-N and NO<sub>3</sub>-N contents were determined at 3, 7, 14, 21, 28, 35, 42, 49, 56, 63 and 70 days after treatment application using standard methods. A Completely Randomized Design (CRD) was used for the experiment with four replicates. Data were statistically analyzed using SAS package.

The variation in soil NH<sub>4</sub><sup>+</sup>-N during the first 3 days of incubation was significantly different ( $P \geq 0.05$ ) in treatment T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. No distinct relationships were found after day 3 of incubation and NH<sub>4</sub><sup>+</sup>-N contents were highly varied throughout the incubation. However, control (T<sub>5</sub>) was found to be significantly differed ( $P \geq 0.05$ ) from other treatments towards the end of the incubation. Furthermore, it was observed that NH<sub>4</sub><sup>+</sup>-N contents were increased at the initial stage of the incubation followed by gradual reductions. Treatment T<sub>2</sub> was found to exhibit the highest NH<sub>4</sub><sup>+</sup>-N contents followed by treatment T<sub>1</sub> and T<sub>3</sub>. Despite the highly varied NO<sub>3</sub>-N contents observed at the initial stages of the incubation, NO<sub>3</sub>-N contents were found to be increased for all the treatments at day 49 onwards. The highest NO<sub>3</sub>-N contents were observed in T<sub>1</sub> followed by T<sub>2</sub> and T<sub>3</sub>. However, repeated application of T<sub>1</sub> had to be done to ensure better performance.

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## 241/B

### Effect of dietary rice bran and energy levels on the digesta transit time of broiler chicken

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Gastric transit time (GTT) of digesta through the digestive tract affects the efficiency of feed digestion and absorption. Meanwhile, a range of animal, dietary and environmental factors governs the gastric transit time of digesta. Two completely randomized design experiments, each having seven replicates were conducted to determine the GTT of digesta of broiler chicken as affected by two dietary rice bran (RB) levels (20 and 40%) and two dietary energy levels (3000 and 3400 kcal/kg). All diets were in mash form. Following a five hours of feed deprivation, broilers were offered experimental diets. Birds were observed for the expulsion of the first faecal pellet. The time between feed offer and the appearance of the first faecal pellet was considered as the GTT. Data were analyzed using GLM procedure of SAS. The digesta transit time (mean±SE) of broilers fed 20 and 40% RB were 199±5.30 and 196±4.54 minutes, respectively and was not significantly affected by the dietary RB level. Dietary energy level also did not have significant effect on the mean gastric transit time. The digesta transit time (mean±SE) of the broilers fed 3000 and 3400 kcal/kg were 216±3.78 and 214±6.43 minutes, respectively. Digesta retention time per 100 g of live body weight was also not altered due either to the dietary energy or rice bran levels. Irrespective of the dietary energy level and RB level the retention time ranged within a narrow range from 12 to 14 minutes per 100g of live body weight. There was no significant correlation between the live weight and the mean digesta transit time. It was concluded that dietary rice bran (20 or 40%) and energy levels (3000 or 3400Kcal/kg) had no effect on GTT of broilers.

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242/B

### Effects of the immersion of poultry meat in citric acid solutions on the organoleptic properties

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Poultry meat is a good source of protein and consumption of the same is less regulated by ethno-religious taboos. Poultry carcasses are immersed in citric acid (CA) solutions to reduce the *Salmonella* contamination. Objective of the present experiment was to evaluate the affect of immersing broiler meat in CA solutions on organoleptic properties of broiler meat. Breast meat samples were immersed in 0, 2% or 4% CA solutions for 20 or 40 minutes. Then the meat samples were boiled for 40 minutes. Sensory evaluation was done for color, odor, taste, texture and overall acceptability with sensory panel of ten people. A meat sample, which was not treated with CA solution, was used as the reference sample. The data were analyzed using Friedman test. Reference sample had comparatively higher scores for all sensory qualities except for odor. Odors of the meat samples treated with 2% citric acid for 20 minutes and 4% citric acid for 20 minutes were better than reference sample. Higher CA levels reduced the sensory qualities (color, odor, taste and texture). Immersion in 4% CA for 40 minutes resulted in the lowest score for color compared to all other CA X time combination. Tastes of all the samples were lower than reference sample. Texture also decreased with increasing CA levels. The overall acceptability of reference sample was also better than other samples. It was concluded that immersion of broiler meat in 2% or 4% CA solutions for 20 or 40 minutes adversely affects some organoleptic properties including taste, texture and overall acceptability.

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243/B

### Low cost medium for germination of spores of *Cyathea walkerae* Hook

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A germination medium of sand, compost and brick pieces and MS medium are commonly used for germination of fern spores with low level of germination percentage and poor growth and development of gametophytes, which hindered large scale production of ferns and studies on their reproductive biology and hybridization. Therefore, the objective of this study was to identify a low cost medium for germination of spores of *Cyathea walkerae* Hook. which is an endemic tree fern in Sri Lanka. Spores for germination were collected from Kanneliya Man and Biosphere reserve. Three media: (i) medium prepared with 1:1:1 mixture of sand: compost: brick pieces; (ii) 0.5 MS medium with three sterilization protocols; and (iii) four concentrations of Albert solution (0.5, 1.0, 1.5 and 2g/l) were used in the experiment. All media were placed in sterilized Petri dishes with 4 replicates for each medium. About 0.01 g of spores were evenly distributed throughout the surface of germination media and kept at room temperature (28-30 °C; 70-80% RH) and at low light intensity in the laboratory. Spore germination and gametophyte development were observed weekly using a light microscope. The green colored area of each medium was measured to estimate the germination percentage. The width and the number of cells in each gametophyte were determined under a light microscope.

Spores of *C. walkerae* were germinated within 7-12 days after sowing (DAS) of spore in all media. About 90 DAS, 50% of germination was observed in sand: compost: brick medium. However, gametophytes in this medium were difficult to observe and to separate from brick pieces for growth and developmental studies, because spores were firmly attached to brick pieces. Only 0.5 MS medium where spores were dipped in an absolute ethanol for 1-3 seconds before sowing was successful with 70% germination. Although germination was successful, observation of individual gametophytes, high cost and contamination are major problems associated with the MS medium. The concentrations of 1.5 and 2.0 g/l of Albert solution showed 100% germination of spores. The size of gametophyte and their growth rate were significantly higher in Albert solution when compared to others. Individual gametophytes can be easily separated and observed in Albert solution thereby facilitate studies on growth and development of gametophyte and their reproductive biology while allowing large scale production of plants.

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## 244/B

### **Influence of varietal differences on sensory qualities of local rice based food products**

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Our ancestors had healthy lives with rice-based foods and rice was the major sources of calories and proteins. Now it is the time to correct the historical mistake made by us, which is the consumption of bread and wheat-related food. Wheat that we eat is not nutritious. Unfortunately, the most nutritious part of the wheat that we eat has been extracted and taken away. We eat only the remnants and import diseases, such as blood pressure, diabetics and other complicated ailments. We spend billions of dollars as our foreign exchange for wheat, while we are self-sufficient in rice, which is very nutritious. It is not difficult to make rice-based products. The quality of the rice based food products may change on content of Amylose and Amylopectin and contents of other nutrition. The composition of rice flour varies according to the grain variety and it affects to quality of rice based food products. A study was carried out at the Rice Research and Development Institute (RRDI), Batalagoda, to identify varieties for different local rice base food products. Six popular rice varieties (Bg 300, Bg 352, Bg 358, Bg 360, Bg 94-1 and, Bg 403) were used to prepare of milk rice, pittu, hoppers, string hoppers and kokis. Methods, which were used in preparation of each product, were the normal traditional procedure. A panel consisting of thirty sensory panelists evaluated sensory qualities of five different rice based food products made up using six varieties, for combination of taste, appearance, aroma, mouth feel and overall acceptability. According to statistically analyzed the data, There is significant difference in sensory quality characteristics between varieties and local rice food products. The study showed that found majority of people preferred for; Milk rice- Bg 300> Bg 352 , Pittu - Bg 94-1>Bg 358, Hoppers- Bg 403> Bg 300 , String hoppers - Bg 358> Bg 94-1and Kokis- Bg 94-1>Bg 300 varieties respectively. Majority of people less preferred food products, which prepared from Bg 360, except pittu.

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**245/B**

**Competitiveness of Sri Lankan fruit and vegetable products in EU market: Company standards and product standards**

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**Key Words**

Fruit and vegetable exports, Product standards, GSP+ scheme

Although Sri Lanka has signed several regional and bilateral trade agreements with South Asian countries, still Western countries play the major role in Sri Lankan agricultural exports. However, a diversity of quality and safety standards exists in western countries, especially in European Union member countries. Therefore, Sri Lankan exports need to maintain safety, quality and environmental friendly standards to be competitive in EU markets.

Objectives of this study were to find the present status of Sri Lankan exports of fruits and vegetables to EU countries and possibilities to improve market opportunities under the GSP+ (Generalized System of Preference) scheme, which is active from 1<sup>st</sup> of January 2005 to 2008. Raw material handling, processing, labour handling and factory environment were considered as company standards under 17 evaluation criteria while packaging, labeling, storage, handling and contamination were considered as product standards under 17 evaluation criteria. The information required were obtained by interviewing stakeholders of fresh and processed fruits and vegetable export industry and by visiting factories to evaluate the standards maintained in both products and companies as a whole. Analysis revealed that Sri Lankan exporters are maintaining an acceptable level of export standards for raw material handling (63%), processing and manufacturing(58%), labour handling (46%), factory environment(57%) in fresh fruit and vegetable exports while good standards for raw material handling (79%), processing and manufacturing(68%), labour handling (74%), factory environment(63%) in processed food and vegetable exports. Product standards also maintained good level (average of 75%) indicating competitiveness in EU market with GSP+ scheme. However, poor concerns given on sanitation, Eco- friendly methods of manufacturing, inadequate quality control systems in the supply chain are being the major constraints in exploiting the EU market opportunities.

As EU countries are highly concern about standards of raw materials, labour, environment and sanitary standards, it is essential to pay more attention to those aspects to improve the quality through cost effective strategies to be competitive in EU markets to reap the benefits of GSP+ scheme.

Competitiveness of Sri Lankan fruit and vegetable products in EU market: Company standards and product standards

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## SECTION D

246/D

### Speciation of essential metals in wound fluids

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An important question in trace metal based wound management is bio availability of the metal ions. Complex forming species like amino acids, peptides, proteins, etc. are also numerous in biological materials. The total ligand concentration in the mammalian body greatly exceeds the metal content and so body tissues and fluids have been linked to arenas in which the various complexing agents compete for different kinds of metal ions, which are present.

In recent years, computer modeling studies (speciation) coupled with analytical methods have led to an increased understanding of the bioavailability of many metals with interesting conclusions. The distribution of essential metal ions amongst the complexes formed was simulated at three distinct pH values i.e. pH 6.4, pH 7.4, pH 8.4 for wound fluids during the healing cascade using a computer aided speciation program. To simulate the wound fluid, experimentally obtained concentrations of iron, zinc, copper manganese and calcium were utilized as total metal concentrations for post surgery day 1, day 3 and day 5.

The speciation analysis showed that the zinc complex with most number of low molecular mass (Imm) ligands in the wound fluid and also it is clear, when in neutral and alkaline pH conditions, the zinc complexation is higher. However the complexation during the healing of wound is more or less constant. Manganese complexes with more Imm ligands in alkaline conditions and also form high concentrations compared to low and neutral pH conditions. Iron complexes with citrate in high concentrations in spite of the acidity and the time of healing cascade. None of the other amino acids complexes with iron except valine. Calcium is in fairly high concentrations as a free metal in bio-fluids and speciation showed that the bioavailability of calcium is not a dependent of pH and the day of sampling. Copper complexes with wide range of Imm ligands in spite of the pH and the day of sampling. The highly formed complex is cu-glutamate and it is some what clear that, healing of wound in lowered pH conditions cu- glutamate is present in higher concentrations around the wound.

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247/D

### Identification of soil- borne fungi associated with export foliage plant nurseries

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Foliage nurseries export their products to the international market as well as the local market. Most of these nurseries are located in Gampha and Kurunegala districts. Soil fungi found in foliage nurseries were surveyed during January 2006 to January 2007. Collected soil samples were analyzed using serial

dilution agar- plate method. Soil –borne plant pathogenic fungi such as *Fusarium* spp., *Pythium* sp., *Aspergillus* sp., *Sclerotium* sp., *Rhizoctonia* sp., *Mucor* sp., *Penicillium* sp., *Phytophthora* spp., *Trichoderma* sp. and *Rhizopus* sp. were identified. Non- pathogenic species such as *Cochliobolus* sp., *Cunninghamella* sp., and *Sporotrichum* sp. were also detected. Identification of the soil- borne diseases and their correct management will enhance the quality of foliage plants.

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248/D

### **An *in vitro* assessment of antioxidant potential of *Trichosanthes cucumerina***

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*Trichosanthes cucumerina* Linn. (Family:Cucurbitaceae), locally known as Dummella is commonly found in Asian countries including Sri Lanka. The aerial parts of *T. cucumerina* are widely used in combination with other plants in the traditional medicinal systems as a remedy for fever, dropsy, acute bronchitis, boils, inflammation, skin diseases, jaundice, diabetes and gastric lesions. The antioxidant properties of aerial parts have not been scientifically investigated so far. However, a close relative of the *T. cucumerina* such as, *T. kirilowii* have shown antioxidant properties. Therefore, this study was undertaken to investigate the antioxidant potential of cold ethanolic extract (CEE) and hot water extract (HWE) of *T. cucumerina* aerial parts using 3 *in vitro* assays: (1) TBARS (thiobarbaturic acid reactive substances) assay, (2) DPPH<sup>·</sup> (2, 2 – diphenyl – 1 – picrylhydrazyl) scavenging assay and (3)  $\beta$  - carotene – linoleic acid model. In addition, total polyphenolic content of CEE and HWE were determined according to the Folin – Ciocalteu colorimetric method.

In TBARS assay, CEE (AI%; Antioxidant Index Percentage  $30.2 \pm 0.6$ ) showed the higher antioxidant potential than that of HWE (AI%;  $26.5 \pm 0.2$ ). Interestingly, in this assay, both CEE and synthetic antioxidant BHT (AI%;  $32.4 \pm 0.8$ ) had same ability of delaying the lipid peroxidation. The scavenging effects of *T. cucumerina* extracts on DPPH<sup>·</sup> radicals decreased in the following order: CEE ( $EC_{50}$ :  $15.7 \pm 0.4$   $\mu$ g/mL) > HWE ( $EC_{50}$ :  $39.2 \pm 0.2$   $\mu$ g/mL). However, the synthetic antioxidants, BHT ( $EC_{50}$ :  $10.6 \pm 0.6$   $\mu$ g/mL) posses higher ability of scavenging DPPH<sup>·</sup>. In the  $\beta$  - carotene – linoleic acid model the AA% (Antioxidant percentage) of CEE ( $81.2 \pm 1.8$ ) was comparable with the synthetic antioxidant, BHT ( $84.2 \pm 1.2$ ). However, the AA% of the HWE ( $76.9 \pm 0.9$ ) was lower than that of BHT. The total polyphenolic content present in HWE and CEE were  $45.4 \pm 0.76$  and  $62.3 \pm 0.30$  mg gallic acid/g extract). According to the results the extracts obtained from aerial parts of *T. cucumerina* had *in vitro* antioxidant activity as judged by TBARS assay, DPPH<sup>·</sup> scavenging assay and  $\beta$  - carotene – linoleic acid model.

In conclusion, these results demonstrate, for the first time, *in vitro* antioxidant activity of *T. cucumerina* aerial parts.

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**249/D**

### **Soil electrical conductivity changes in tsunami affected Southern coastal belt in Sri Lanka**

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The deterioration of soil fertility due to the salt pollution of agricultural fields has been a major concern since the 26th of December 2004, when the tsunami ravaged thousands of kilometers of coast along the shore of the Indian Ocean penetrating from 0.5 km up to several kilometers inland. In addition, it also poses a major environmental hazard by degrading the quality of groundwater, decreasing wildlife diversity, degrading roads. The main objective of the present research study is to investigate and identify soil Electrical conductivity changers in tsunami affected and unaffected areas.

Within this study area 21 auger points were selected to for collect soil samples and auger points are represent both tsunami affected and non affected area. From each auger point, soil samples were taken from surface layer and each 50 cm depth until reach water table and also water samples were taken from auger holes and from dug wells near to auger holes. Soil physical parameters such as specific gravity, soil moisture, were determined. Soil chemical parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), and salinity were measured using pH meter and EC meter. The electrical conductivity (EC) of the soil in the tsunami affected area varies from 100  $\mu\text{S}/\text{cm}$  to 422  $\mu\text{S}/\text{cm}$ . A direct relationship between EC and soil depth can be detected. This may be due to salt leaching from surface layers toward the lower depth in tsunami affected areas. This may be the tsunami saline water deposit in the unsaturated area above the water level dissolved by atmospheric precipitation in to the groundwater.

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**250/D**

### **Variations of metals in the unsaturated soil cover of the Southern coastal belt**

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In the southern coastal line the affected area by the tsunami wave is about 1.5 km inland. Water from the Tsunami wave caused contamination of large areas of soils. The sediments making up the coastal aquifer are mostly structure less sand ranging from fine to moderately coarse. The aquifers are unconfined, shallow and very permeable and hence prone to be contaminated from leaching metals.

Further the quality of ground water depends on the quality of soil. Hence there is a necessity to assess the risk that the Tsunami wave poses to soil.

Hence the determination of metals in the soil down to the groundwater level was carried out. 27 points, from both affected and unaffected areas from the Tsunami wave, along the south coast were selected from Midigama to Matara for the auguring of soils. Points of auguring are located within 2 km from the coastal belt and 4 km distance from one point to another. Soil samples were collected in each site, from 50 cm depths from the surface, down to the water level. Geological positions of each site were recorded using the GPS.

Collected soil samples were air dried for overnight and sieved using 2mm sieve. 0.5g of soil was digested in a mixture of HNO<sub>3</sub> and HCl and diluted to 50 mL prior to analysis by Atomic Absorption Spectrophotometry (AAS). K, Mg, Na, Mn, Zn and Fe were measured by flame AAS and Cd, Cu and Pb were determined using graphite furnace AAS.

The results showed that that the groundwater level is deep in the unaffected area. In the affected area K (max 54.1 mg/g soil), Mg (max 234.3 mg/g soil), Mn (max 149.5 mg/g soil), Zn (max 99.5 mg/g soil) and Fe (max 389.8 mg/g soil) are present in higher amounts than others and Cd and Pb are present in very low amounts. The maximum (747.4 mg/g soil) and mean values (448.4 mg/g soil) of Na are always higher. It is higher in the surface and also close to the water level. This could be due to the fact that Na leach from water to the soil and the Na levels are still high in the affected area. Some of the other metals are also higher in the affected area and some heavy metals show that they have deposited on the middle layers of the soil. The surface soils are now disturbed and could have been influenced by many factors, rain, wind etc. but the heavy metals deposited in the middle layers are remaining.

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## 251/D

### **Accumulation of heavy metals by three moss species and selection of the best candidate as a bioindicator**

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Three moss species, *Barbula sp. 1*, *Barbula sp. 2* and *Bryum sp.* were used as bioindicators to monitor heavy metal accumulation (Pb, Ni, Cu Cr and Cd) in 12 sampling sites in Sapugaskanda industrial area where all three species were distributed commonly in all the sites. Identification of collected mosses was done with the comparison of authenticated specimens of National Herbarium, Peradeniya. Bioaccumulation ability in these three mosses was evaluated by Atomic Absorption Spectrophotometry (AAS).

The results indicate that the *Barbula sp. 2* absorbs metals Pb, Ni and Cu from atmospheric deposition more effectively compared to other two moss species. The high sensitivity to Cd and Cr was seen in *Barbula sp. 1*. However, this study shows that the most suitable species for heavy metal deposition studies as *Barbula sp. 2* in which the concentrations of heavy metals are found to be higher than in other species.

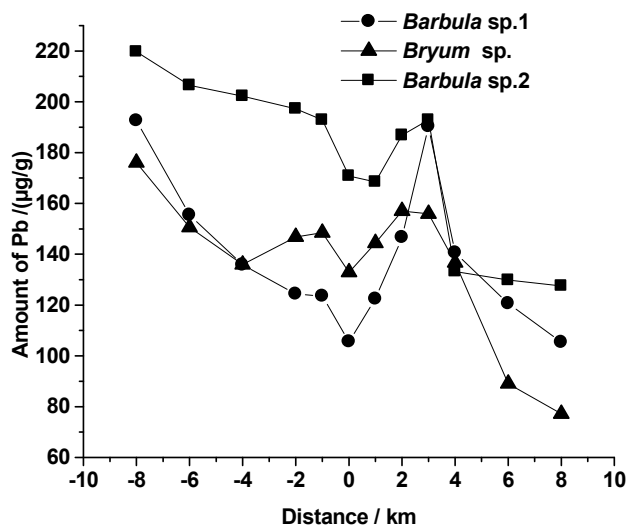


Figure 1 Concentration of Pb in three moss species

Sapugaskanda oil refinery was taken as the centre and distances were indicated with reference to the oil refinery. Towards Northeast considered as positive values and to the Southwest considered as negative values.

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252/D

### Effect of different methods of weed management on soil erosion in tea lands at low elevations

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This experiment was conducted to study the effect of different weed management methods on soil erosion in tea lands during south west monsoon period. Vacant patches of a sloping land were selected. On the slope, 20 plots measuring 2x1m (2m down the slope) were demarcated by using wooden flacks right round the plot leaving 5cm above the soil surface. Eroded soil from each plot was collected in to a polythene bag kept in a soil pit immediately below the plot. Five methods of weed management i.e.(1.spraying paraquat, 2.Spraying Glyphosate, 3.Hand weeding, 4.Scraping with sorandies and the 5.control (Un weeded) were tested. There were four replicates in a RCBD design. Weights of eroded soil were measured after each rain and were recorded for 10 weeks after imposition of treatments. The collected data were statistically analyzed using GLM procedure. Results showed that the soil loss from the tea lands at the experimental site at low elevation varied from 1-8 t/ha during south west monsoon, depending on different weed management methods. The use of systemic weedicides contributed to more soil erosion than contact weedicides. Among the all the weed management methods, Scraping resulted the highest amount of soil erosion on sloping tea lands.

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253/D

### **Vegetative propagation of mangroves by propagule cuttings**

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Mangrove forests are threatened world wide, because of intervention by man. Mass production of planting material and successful germination of seeds are essential to rehabilitate degraded mangrove areas. A propagule of *Rhizophora apiculata* was cut into 3-4 pieces and cuttings were treated with phenol removing solution and then they were treated with root promoting hormones. Root promoting hormones, Indol Butyric Acid (IBA), Naphthalene Acetic Acid (NAA) and combination of both were used to increase the efficiency of root initiation. Five concentrations (100 ppm, 500 ppm, 1000 ppm, 1500 ppm and 2000 ppm) of above hormones were tested by using six replicates for each concentration for efficiency. Root lengths were measured after one and two months of planting and shoot heights were recorded after shoot initiation in relation to hormone concentrations and it was found that IBA (1000 ppm) produced the maximum root length and shoot height among all three treatments. Vegetative propagation methods provide an alternative method of producing mangrove seed material in large scale. In the present study efficacy of producing seed material by propagule cutting of *R. apiculata* supported with root promoting hormones, Indol Butyric Acid (IBA), Naphthalene Acetic Acid (NAA) was investigated.

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## SECTION E2

254/E2

### Effect of temperature on Cu (II) – feldspar interaction

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Aqueous feldspar suspensions show a great affinity towards Cu(II) ions at low concentration levels. The partitioning of aqueous solutions of Cu(II) ions with feldspar suspensions leads to a significant removal of Cu(II) ions from aqueous solution. According to atomic absorption measurements, the percent removal of Cu(II) from 5.00 ppm standard CuSO<sub>4</sub> solution when treated with 5.000 g of powdered feldspar with diameter of less than 1.18 mm is increased from 76.4 to 95.5 when the temperature of the Cu(II)-feldspar system is increased from 293 K to 323 K. Consequently, the apparent partition coefficient,  $K_D$ , values of interaction of Cu(II) with feldspar increases with temperature indicating endothermic behavior for the transfer of Cu(II) ions from the aqueous phase to the solid feldspar phase. The standard Gibbs free energy change ( $\Delta G^\circ$ ) of this transfer process, as calculated with the aid of standard thermodynamic relationships, varies from -8.48 kJ mol<sup>-1</sup> to -14.4 kJ mol<sup>-1</sup> within the temperature range of 293 K and 323 K. Further, the  $K_D$  values obtained at different temperatures fit the linear form of the van't Hoff equation, with a high regression coefficient of 0.993, resulting in an average standard enthalpy change ( $\Delta H^\circ$ ) of 52.7 kJ mol<sup>-1</sup> over the above temperature range.

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255/E2

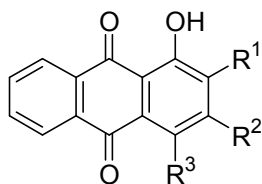
### Ayurvedic medicinal oils : Selective incorporation of constituents of *Rubia cordifolia* into 'Pinda' oil

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*Rubia cordifolia* is one of the plants used in the preparation of 'Pinda' oil, which is widely used for skin disorders. As a part of our on going studies on the chemistry, standardization and quality control of Ayurvedic drugs, 'Pinda' oil was analyzed for the constituents of roots and stems of *R. cordifolia*. For this, 'Pinda' oil of a reputed manufacturer was subjected to a series of solvent – solvent partitioning and TLC systems were developed to separate the constituents in it. Methanol extract of roots and stems of *R. cordifolia* was also partitioned and was further fractionated to isolate the major constituents. This led to the isolation of rubiadin (1), xanthopurpurin (2), munjistin methyl ester (3), purpurin-2-methyl ether (4), 2-methyl-1-hydroxy-9,10-anthraquinone (5) and  $\beta$ -sitosterol, while two other common anthraquinones, alizarin (6) and purpurin (7) were isolated from alum solutions obtained from *R. cordifolia* soaked in HCl. Identification of these compounds was done by their melting points, UV, IR, LC-MS, and NMR data. The TLC comparisons of fractions of 'Pinda' oil and the compounds isolated from roots and stems of *R. cordifolia* showed that, out of the seven anthraquinones, only four i.e. (1), (2), (6), (7) and  $\beta$ -sitosterol have been incorporated into 'Pinda' oil.



- | R<sup>1</sup> = CH<sub>3</sub>, R<sup>2</sup> = OH, R<sup>3</sup> = H, rubiadin
- | R<sup>1</sup> = R<sup>3</sup> = H, R<sup>2</sup> = OH, xanthopurpurin
- | R<sup>1</sup> = COOCH<sub>3</sub>, R<sup>2</sup> = OH, R<sup>3</sup> = H, munjistin methyl ester
- | R<sup>1</sup> = R<sup>3</sup> = OH, R<sup>2</sup> = OCH<sub>3</sub>, purpurin 2methyl ether
- | R<sup>1</sup> = CH<sub>3</sub>, R<sup>2</sup> = R<sup>3</sup> = H, 2-methyl-1-hydroxy-9,10-anthraquinone
- | R<sup>1</sup> = OH, R<sup>2</sup> = R<sup>3</sup> = H, alizarin
- | R<sup>1</sup> = R<sup>3</sup> = OH, R<sup>2</sup> = H, purpurin

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**256/E2**

### **Survey of tri halo methanes (THM) in public water supplies**

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In almost all water treatment processes for human consumption, chlorine is the most commonly used disinfectant due to its effectiveness and low cost to deactivate microorganisms and/or to ensure the residual concentrations in drinking water distribution systems thus protecting from micro organisms re growth. Chlorine can react with naturally occurring organic substances such as humic acid and fulvic acid to form a wide variety of disinfection by- products (DBPs), many of which are known to be carcinogens (US EPA method 502.2). The main objective of this survey is to determine the Tri Halo Methane (THM) concentrations present in chlorinated water, supplied by Greater Colombo water treatment plants. Tri Halo Methanes are the major type of Disinfectant By Products (DBP's). Samples were collected regularly (7 times) from Ambathale, Labugama and Kalatuwawa over a period of 11 months. Samples were collected from 4 treatment plants at Ambathale and the pre-chlorination and post chlorination steps of Labugama & Kalatuwawa for Chemical Oxygen Demand (COD) and Total Tri Halo Methanes (TTHM) analysis. (sum of 4 compounds viz. Tri Chloromethane, Bromo Dichloromethane, Dibromo Chloromethane and Tribromo Methane)

The investigation revealed that THMs are present in the chlorinated drinking water but concentration of Total THMs are below the WHO and US EPA limits and the limits are 100 µg/L and 80 µg/L respectively. COD of all samples was below 2 mg O<sub>2</sub>/ L. Stability of the 4 compounds was also studied. Trichloro Methane (TCM) is the most unstable compound. Other three compounds change slightly and behavior is almost same. Concentrations of all four compounds decrease with time in the normal environmental conditions.

Several THM removal methods were tried for samples containing TTHM viz. Aeration, Boiling, Sonication and passing through activated carbon. They were all found to be efficient and practical methods, which can be applied for removal of THMs.

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### Physicochemical properties of three rice varieties related to Noodle quality

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Physicochemical properties of rice (*Oryza sativa*. L) varieties, Bg 300, Bg 352 and At 405 and their suitability for making noodles were evaluated. Studies on physicochemical properties revealed that the rice variety Bg 352 had significantly ( $p < 0.05$ ) high amylose content (25.1 %), low gel consistency (56 mm) and high gelatinization temperature (GT) (51 °C). Pasting behaviour such as peak viscosity (PV), hot paste viscosity (HPV), cold paste viscosity (CPV), setback and Amylogram consistency were shown to be significantly higher for Bg 352. High HPV indicates low cooking loss and superior eating quality, while high CPV relates to high resistance to shear.

Rice variety Bg 352 yields noodles with significantly ( $p < 0.05$ ) lower cooking loss. Amylose content and GT are positively correlated with swelling ratio ( $r = 0.88$ ,  $p < 0.001$ ), Breakability ( $r = 0.88$ ,  $p < 0.001$ ) and firmness ( $r = 0.91$ ,  $p < 0.001$ ) while, negatively correlated with Cooking loss ( $r = -0.82$ ,  $p < 0.05$ ) and adhesiveness ( $r = -0.69$ ,  $p < 0.05$ ). Sensory evaluation of noodles showed ( $p < 0.05$ ) significantly lower scores for appearance, odour, elasticity and stickiness for At 405. Noodles from Bg 352 and Bg 300 did not show any significant difference. The sensory qualities and textural qualities of noodle made out of Bg 352 have the qualities, which are expected by the Sri Lankan consumers from noodles. Therefore the rice noodles made from high amylose, GT, PV, CPV and SB of rice varieties have better eating quality and desirable textural characteristics.

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### Chemistry of endophytic microorganisms from seaweeds

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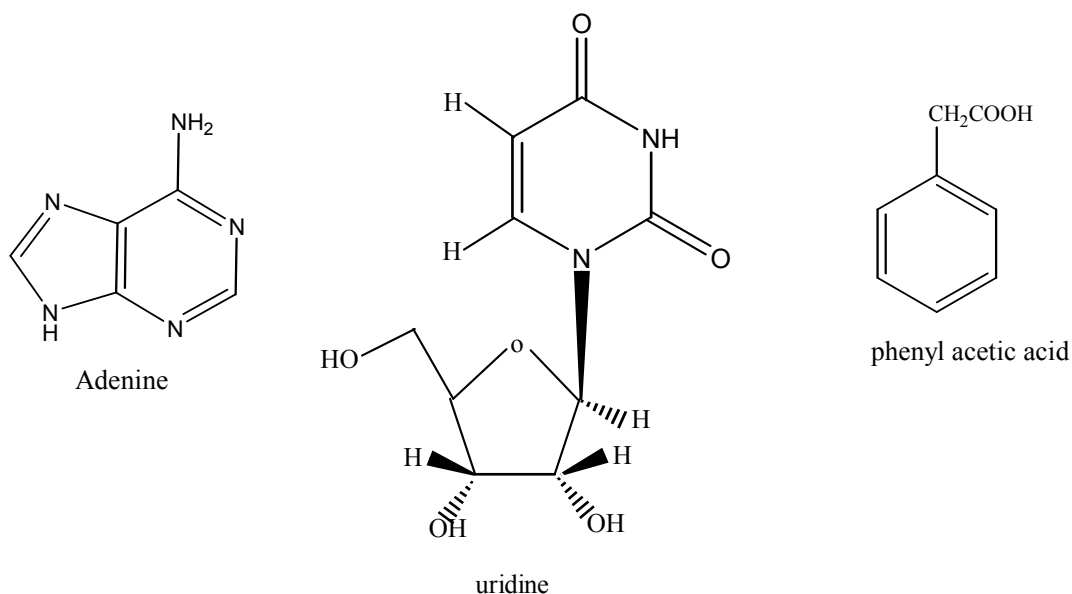
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Endophytes are fungi or bacteria, which for all or part of their life cycle, invade the tissues of living plants and cause unapparent and asymptomatic infections entirely within plant tissues, but causes no symptoms of the disease. The same organism may also be described as a saprobe or pathogen at other times. They are increasingly being identified as a group of organisms capable of providing a source of secondary metabolites for use in biotechnology and agriculture. Some of these compounds may be medically interesting, especially if they possess anticancer, antifungal, antibacterial, antimalarial and a variety of other biological activities.

In order to acquire endophytes, we selected marine algae (seaweeds) of interest and 8 endophytic fungal strains were isolated. Fungal species obtained from *Sargassum wightii* Greville (Brown algae) were cultured in large scale to obtain fungal extracts. The extract (3.6g) from the fungal species obtained from *Sargassum wightii* Greville was injected to a high performance liquid chromatography unit coupled to mass spectrometer (HPLC-Ms), and a number of peaks with molecular masses of  $m/z$  135, 136, 220, 226, 228, 244, and 260 due to different compounds was observed. The above EtOAc

extract (1.7g) was subjected to normal column chromatography using increasing amount of MeOH in dichloromethane as the solvent gave a number of fractions. Further purification of above fractions by repeated Reverse Phase column chromatography on RP 18 gave three compounds in small quantities. The compound with molecular mass 135 was confirmed as adenine by comparison of its' NMR and MS data with reference spectra. The second compound with the molecular weight 244 was identified as uridine and the third compound with molecular weight 136 was characterizes as phenylaceticacid in the same way.



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259/E2

### Allelopathic activity studies of Sri Lankan flora

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The definition of allelopathy is the directly or indirectly harmful or beneficial effects of one species (Plants, bacteria, fungi) on another species through the production of chemical compounds that escape into the environment. It is estimated that there are about 1,400,000 compounds in plants with allelopathic activities, of which only 3% have been examined. The remainder is unknown and might contain very promising growth inhibitors that could be successfully exploited for the development of bio-pesticides and herbicides.

The water extract of leaves of *Tithonia diversifolia*, leaves and stem of *Mikania scandens*, *Clidemia hirta*, bark of *Canarium Zeylanicum*, rhizome of *Calamus totang* have shown significant difference in the average radicle length, compared to the control. The water extract of leaves of *Tithonia diversifolia*, *Myristica fragrans*, *Tagete erecta*, *Impatiens balsamina*, *Morinda citrifolia*, leaves and stem of *Mikania scandens*, *Wedelia trilobata*, bark of *Alstonia scholaris*, have shown significant difference in the average hypocotil length, compared to the control. When EC<sub>50</sub> values of tested plants compared, it is showed that *Mikania scandens*, *Tithonia diversifolia*, *Lantana camara* and *Canarium Zeylanicum* showed remarkable activity. *Tithonia diversifolia* and *Lantana camara* are previously

reported as allelopathic active plants. The present studies were focused on plant *Mikania scandens*. The shade dried and milled leaves and stem were successively extracted with hexane, dichloromethane, ethylacetate and methanol. Seed germination bioassay was carried out for these extracts. Dichloromethane extract of *Mikania scandens* showed 100% seed inhibition activity and isolation of allelochemicals from this extract will be in progress.

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260/E2

### Cantaloupe melon as a solution for vitamin A deficiency

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Vitamin A deficiency is one of the major health problems prevailing in Sri Lanka, which especially affects preschool children. Cantaloupe melon (*Cucumis melo* reticulatus) is becoming a popular fruit eaten either raw when ripen or as a dessert with sugar or ginger preserves. Although it is considered to be rich in carotenoids, no attempts have been made to study cantaloupe melon with regard to carotenoid content or their bioavailability. Therefore, a study was carried out to quantify  $\beta$ -carotene in cantaloupe melon available in the local market and to measure the *in vitro* accessibility of  $\beta$ -carotene using an *in vitro* method. Well matured and ripen cantaloupe melon fruits were purchased from the local market for the study. Fruits were selected basing on their rind color and the fruit shape. Carotenoids from cantaloupe melon were extracted according to the method of Rodriguez Amaya (1999), which involved extraction of carotenoids, partition to petroleum ether, separation of carotenoids by Open Column Chromatography (OCC), identification of carotenoids using Ultra Violet Visible absorption spectra (maximum absorption and spectral fine structure), order of elution in OCC and chemical tests. Purity of the identified carotenoids was further confirmed by using the HPLC with photo diode array detection. Mobile phase consisted of acetonitrile, methanol and ethyl acetate containing 0.05% of TEA (Trimethylamine) and the gradient used was 95:5:0 to 60:20:20 in 20 minutes and this proportion was maintained during the entire run at a flow rate of 0.5ml/min. As for the *in vitro* accessibility, the fruit pulp was homogenized into small pieces, sizes of which were similar to those of contents in the bolos after chewing and was subjected to an *in vitro* digestion procedure according to Chandrika *et al.* (2006). Cantaloupe melon had  $\beta$ -carotene  $26 \pm 8 \mu\text{g /g FW}$  (on fresh weight basis) as the major carotenoid and small amounts of lutein and lycopene containing  $0.4 \pm 0.1$  and  $0.2 \pm 0.1 \mu\text{g/g FW}$  respectively. However, cantaloupe melon was found to contain more  $\beta$ -carotene than any other known  $\beta$ -carotene rich fruits so far studied by our group. The *in vitro* bioaccessibility of cantaloupe melon was found to be very high (71 $\pm$ 11%). Hence, it can be considered that cantaloupe melon is a good source of  $\beta$ -carotene with a higher bioavailability and that 100g of cantaloupe melon contributes to the Recommended Daily Allowance (240% with regard to RDA) of Vitamin A significantly.

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### Red fleshed guava as source of lycopene

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Evidences based on epidemiologic studies indicate that diets containing lycopene can lower a wide range of cancers like prostate gland cancers, colon, bladder and breast cancers and several other chronic diseases. These health benefits are probably linked with antioxidant properties of lycopene. It is also believed that commodities like guava are rich in lycopene hence are cheaper sources of these carotenoids. Aim of the present study was to quantify carotenoids in local red fleshed guava (*Psidium guajava*) and to determine the *in vitro* bioaccessibility of the carotenoids. Even though the lycopene content of Brazilian guava varieties was reported there were no reports on horana red variety of guava carotenoids. For the study, the guava variety Horana Red was obtained from Horticultural Crop Research and Development Institute Gannoruwa, Kandy, Sri Lanka. Five fruits of the Horana Red variety selected randomly were analyzed separately, Carotenoids from guava were extracted according to the Rodriguez Amaya (1999), which involved extraction of carotenoids, partition to petroleum ether, separation of carotenoids by Open Column Chromatography (OCC), identification of carotenoids using Ultra Violet Visible absorption spectra (maximum absorption and spectral fine structure), order of elution in OCC and chemical tests. Purity of the identified carotenoids was further confirmed by using the HPLC with photo diode array detection. Mobile phase consisted of acetonitrile, methanol and ethyl acetate containing 0.05% of TEA (Trimethylamine) and the gradient used was 95:5:0 to 60:20:20 in 20 minutes and this proportion was maintained during the entire run at a flow rate of 0.5ml/min. In the study of *in vitro* accessibility, fruits were initially homogenized into small pieces whose sizes resembled to the magnitudes resulted from chewing in the mouth in normal bites and was subjected to an *in vitro* digestion procedure according to Chandrika *et al.* (2006).

It is revealed that guava Horana Red variety had a high content of lycopene ( $45.3 \pm 8.1 \mu\text{g/g}$  on fresh weight basis (FW)) along with some other carotenoids like lutein and  $\beta$ -carotene in small amounts containing  $2.1 \pm 0.6 \mu\text{g/g}$  and  $2.0 \pm 0.2 \mu\text{g/g}$  (FW) respectively.  $\beta$ -cryptoxanthin was found in trace amounts in the guava variety. The *in vitro* accessibility of lycopene in guava was found to be 73%. Moreover, guava can be ranked as commodity to contain more lycopene than many other lycopene containing fruits such as watermelon, papaya and tomato. Accordingly, Horana red variety of guava can be considered as a rich lycopene source.

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262/E2

### Determination of heavy metals in bed sediments of selected water bodies in the Greater Colombo area

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Sediments are sinks for many types of pollutants in aquatic systems. However, there are certain environmental conditions under which these pollutants can be released back to the water. Of these pollutants, heavy metals are of particular importance due to their environmental persistence. The aim of this study was to determine the levels of Zn, Pb, Cu, Fe, Ni, Cr and Cd in the sediments of selected water bodies in the Greater Colombo area. Samples were collected during Aug. 2006 - March 2007 under dry and calm weather conditions from Beira Lake (8 stations; 4 close to inlets, 2 close to banks, 2 from middle), St. Sebastian Canal (10 stations; 4 close to inlets, 6 near banks), Dematagoda Canal (5 stations; 2 close to inlets, 3 near banks), Wellawatte Canal (5 stations, 1 close to inlets, 2 close to banks, 2 from middle) and Heen Ela (5 stations; 2 close to banks, 3 from middle). Three - five samples were collected from each station. The metals were extracted as acid extractable (total) and exchangeable fractions using the standard "HNO<sub>3</sub> acid digestion method" and "ammonium acetate buffer solution method" respectively, and metal ion concentrations were determined using Flame Atomic Absorption Spectrophotometry.

The highest polluted water body in terms of acid-extractable (total) fraction of Zn, Pb, Cu, Cd and Fe was St. Sebastian Canal (Zn: 560 to 1553 µg/g of dry wt., Pb: 120 to 299 µg/g of dry wt., Cu: 111 to 521 µg/g of dry wt. and Cd: 3 to 6 µg/g of dry wt., Fe: 35.8 to 59.3 mg/g of dry wt.) while Heen Ela contained the highest levels of total Ni (25 to 50 µg/g of dry wt.) and Cr (75 to 114 µg/g of dry wt.). The standard deviation was less than 3% of the value in all instances. All the metals were present at the sites sampled in all the water bodies, except for Cd at Dematogoda Canal. With the exchangeable metals, Zn and Fe were detected in all the water bodies. Pb and Cu were not detected in Heen Ela and Wellawatta Canal respectively. These metals were also not detected at several sampling points in St. Sebastian Canal. Cd, Cr and Ni were detected only in Beira Lake, except for Ni being detected at one sampling point in Dematogoda Canal. This more bioavailable exchangeable fraction as a percentage of the total metal concentration, was less than 50% for all the metals, with the exception of Cd, Ni and Cr in Beira Lake. With most of the metals, significant variations were observed between sampling stations within a water body, for total as well as exchangeable metals. The levels of many of these heavy metals were higher than those obtained from a similar study carried out in 1999. The source/s of these heavy metals should be determined in order to take appropriate pollution control measures.

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### The carotenoids of *Pouteria campechiana* (sinhala: *ratalawulu*)

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The common yellow *lavalu* has been identified as *Pouteria campechiana* (Sinhala: *Ratalawulu*). Samples were collected from, Kadawata, Kurunegala, Makola, Maharagama, Nawala and Peradeniya (Gampaha, Colombo, Kurunagala and Kandy districts). The carotenoids were dominated by neoxanthin. Total carotenoid content was high and varied from 1.9 to 23.5 mg.g<sup>-1</sup> dry weight (DW). Individual carotenoid concentrations varied markedly from specimen to specimen. (□-carotene, from traces to 156, æ-carotene, trace amounts, □-cryptoxanthin, from traces to 1106, violaxanthin, from <188 to 1151, neoxanthin, from 1594 to 19,270, unidentified I, from traces to 627, unidentified II, from 68 to 1162, ig.g<sup>-1</sup>DW). Due to the presence of a carbohydrate gum the normal extraction procedure

for carotenoids had to be modified. Identification was done after separating by open column chromatography (OCC) by using visible spectral data, chemical tests, thin layer chromatography (Tlc) as well as high performance liquid chromatography (HPLC). Quantification was mainly carried out by HPLC using  $\alpha$ -apo-8'-carotenal as the internal standard. Results showed two extremes of retinol equivalents (RE) in *Pouteria campechiana* (traces and 759 to 11,813 RE .100g<sup>-1</sup> DW). These ranges as well as the varying shapes of fruit are indicators that the trees are extremely hybridized. However, its carotenoid profile and high colour intensity could give rise to antioxidant properties and also find use as a natural food colourant as it has an unusually high concentration of total carotenoids.

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