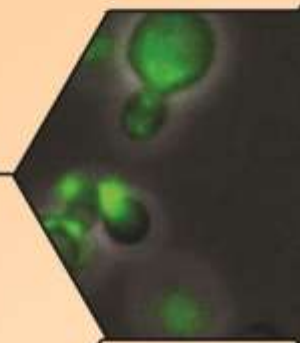




# *Research Projects Completed During 2008 - 2015*

*Research Division*  
**National Science Foundation**



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# Optimization of the growth process of cadmium sulfide (CdS) semiconductor thin films for efficiency enhancement in CdS/CdTe solar cells

RG/2012/BS/04

**Principal Investigator:**

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**Co-Investigators:**

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National Institute of Fundamental  
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Preparation of cadmium sulfide (CdS) thin films on FTO glass substrates using an especially designed multiple sample holder.

## INTRODUCTION

In line with Sri Lanka's national policy to increase the contributions from renewable energy, research and development of low cost and high efficiency solar cells is vital.

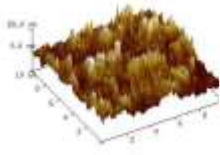
This project focused on optimizing the cadmium sulfide (CdS) window layer for CdS/CdTe thin film solar cells for improving their efficiency.

## PROJECT ACHIEVEMENTS

Under this project we have optimized the CdS window layer grown by chemical bath deposition method by controlling the film thickness, thermal annealing time, doping with indium (In) and by introducing a TiO<sub>2</sub> buffer layer.

After fabrication the full CdS/CdTe solar cell with optimized CdS layers and CdTe layer deposited by Physical vapour deposition method, and subjected to CdCl<sub>2</sub> treatment, the best solar cells showed an efficiency of 7 %.

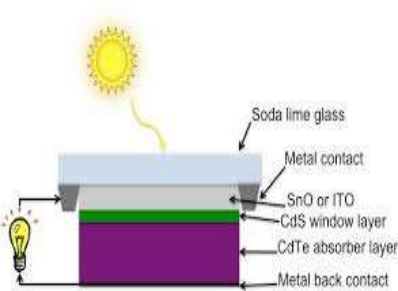




Atomic Force Microscopic image of surface morphology of Cadmium Sulfide (CdS) film formed on FTO glass substrate

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

We have mastered the technique of fabricating practical CdS/CdTe solar cells with moderate efficiency. More work is needed to improve the efficiency further. An M.Phil. student has been trained who can contribute her knowledge and experience to a relevant or related S&T sector employment.



Schematic diagram of a CdS/CdTe thin film solar cell

## FOLLOW-UP

In order to harness the full benefits of the achievements from this research project, the Research and Development (R&D) phase of about 2-3 years duration needs to be carried out focusing on higher efficiency, lab scale, prototype and commercial scale solar cells/solar panels.

Once commercial scale solar panels are manufactured they can make a significant contribution to Sri Lanka's economic development.

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# Determination of the effect of silicon on natural defense system against anthracnose disease and some pre and postharvest qualities in *Capsicum annum* L. (Malumiris) and investigating the possibility of using rice hull as a low cost silicon source

RG/2012/AG/04

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## Co-Investigator:

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Department of Natural Sciences  
Open University of Sri Lanka



Non circulated liquid hydroponic boxes and simplified hydroponic boxes

## INTRODUCTION

Anthracnose is one of the major diseases of capsicum (*Capsicum annum* L.) causing higher postharvest loss. Control of the diseases is currently achieved by fungicides which are hazardous on environment. Application of Silicon has long been proven effective in controlling diseases. This research was conducted to investigate the effect of silicon, as form of chemical (pottasium silicate) or as natural source (rice hull) on improving the pre and postharvest qualities of capsicum grown in soil free system of cultivation. The potassium silicate was used in the plants grown in non- circulating hydroponics system and the raw rice hull was incorporated as the inert media for growing plants in simplified hydroponics system.

The resistance against anthracnose disease was tested in capsicum fruits by challenged inoculating *Colletrotrichum* spp. The postharvest quality: fruit firmness, physico chemical properties (TSS, TA & pH) and sensory properties of capsicum from Si treated and non treated plants were also investigated. The possible mechanism underlying the silicon mediated disease resistance was investigated by measuring cuticle thickness, level of phenols and studying fungal appressoria formation.



Lesion Development on fruits from simplified hydroponics system and control fruits



Carrying out the sensory evaluation of capsicum fruits from Si treated and non treated plants

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**PROJECT ACHIEVEMENTS**

Application of 75mg/L silicon is an effective method for controlling the anthracnose disease caused by *Colletotrichum capsici* or *C. gloeosporioides* in capsicum. The Root application of 75 mg/l of Si during only blooming stage would be optimum and economical against the anthracnose disease of capsicum 'Muria F1' grown in liquid hydroponic system. Rice hull leachate was effective for overall performance of the capsicum. The current nutrient solutions used for hydroponics systems of cultivation could be effectively replaced by the new nutrient formula produced by incorporating silicon. Plants grown in the simplified hydroponic system showed about 80% of anthracnose disease reduction and enhanced fruit firmness. There were no changes observed in sensory properties of silicon treated fruits. The silicon treated fruit exhibited significantly higher cuticle thickness, higher level of cell wall bound phenols and higher number of appressoria of fungi indicating resistance mechanisms of the silicon treated capsicum fruit.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The alternative method of using silicon to control the disease instead of using agrochemicals will greatly benefit the small, medium and large scale vegetable industries by, minimising the expenditure for the pesticides, improving the quality and yield of the produce and making it more economical due to the availability of low cost silicon sources such as rice hull. The people will be benefited with the fungicide free produce and reduced vegetable price due to minimizing of crop loss. Silicon application appear to be available option for disease management by reducing fungicide, insecticide and pesticide use and therefore potential environmental threats can be reduced.

**FOLLOW-UP**

The nutrient solution used for this research is novel and was formulated by incorporating silicon to the media and by considering the plant requirement to growth and blooming. It is low cost and could be replaced for commercially available expensive solution systems use for growing plants in hydroponics system. The patent documents have already been submitted for the new nutrient formula produced for this purpose. The effect of Si supplement by the new nutrient formulations can be tested for other crops as well. The effect of application of higher concentrations of Silicon as a foliar spray would be important for easy and practical application of Silicon. Further studies should be carried out on this and if it becomes successful it can be practiced for the crops grown in soil as well. Simplified hydroponics system can be specially recommended for the busy urban community living in housing schemes for their home gardening. Further investigations are needed to investigate the possible mechanism/s by which Si suppressed the anthracnose disease of capsicum.



# Near Atmospheric plasma enhanced chemical vapor deposition for surface modification and thin film deposition

RG/2011/NANO/03

## Principal Investigator:

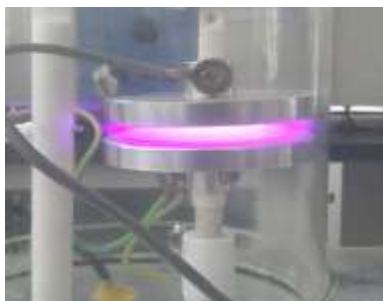
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Department of Chemistry  
University of Sri  
Jayewardenepura



Near atmospheric pressure  
glow plasma generated at  
SLINTEC

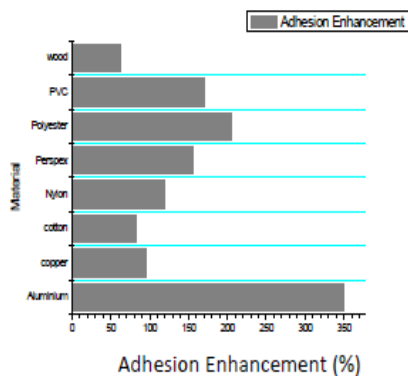
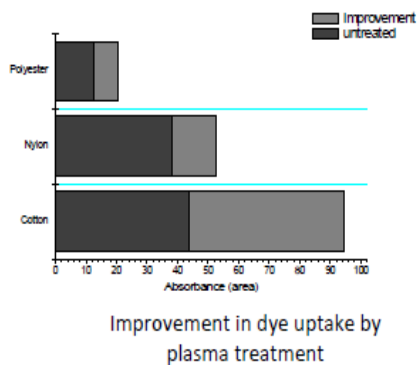
## INTRODUCTION

The project was initiated with the objectives of creating Plasma generation capability at near atmospheric pressures and to conduct experiments in the plasma phase to utilize its unique effects. During the study, metal, polymer and rubber surfaces were modified/ functionalized while in achieving the main objectives of the project.

## PROJECT ACHIEVEMENTS

Non-thermal near atmospheric pressure plasma was successfully generated and characterized. The surface modification of Local Rubber was observed through Fourier Transform Infrared spectroscopy. The data shows clearly the FTIR analysis for rubber, cotton and nylon brings the evidence of material surfaces being modified with nitrogen and oxygen involved functional groups as  $-NH_3^+$ ,  $-$ ,  $NH$ ,  $C=N-$ ,  $-OH$ ,  $CH_2$  by the developed air plasma treatment.

Furthermore, the applied experiments indicate a dye absorbance of fabric materials of Cotton, polyester, Nylon improves its absorbance respectively by 115%, 65% and 36.8% with 5 minutes of exposure time. The Adhesion properties of aluminum increased over 300%, For Polyester, PVC and Perspex, the increase was approaching 200%. Copper, nylon, wood and cotton increased their adhesion properties by around 2x. In addition, 150W 5 minutes of RF air plasma treatment ensures the removal of almost all the organic contaminations on glass surface.



## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The enhanced properties of Adhesion, dyeing, non-chemical and non-contact quick sterilization are industrially relevant for the Apparel, Rubber and Plastics industries.

Namely the apparel sector has an immense energy need for the dyeing of fabrics, especially nylon based materials. Through the use of plasma surface treatment, it is possible to increase the dye uptake thus reducing the energy cost associated with heat and pressurization.

Furthermore, the bonding ability of a plasma treated surface shows significant increase in its tensile strength. The global high technology move towards seamless garments can thus be facilitated via a bonding method of plasma treated surfaces rather than sewing.

In the Field of polymers, surface decoration and bonding to other materials are essential for end user products. Currently such requirements are met through high cost bonding agents. Given that we import these treatments, this is a significant outflow of otherwise local revenue. Results discussed above showcase the ability of plasma technologies relevance in these areas.

## FOLLOW-UP

Project is expected to be expanded further with the objectives of developing an APPJ (Atmospheric Pressure Plasma Jet) system and expand the study towards more advanced materials (ex. graphene), composites and material interfaces as metal-rubber bonding.

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## Water based UV-curable polyurethane latex coatings with nanoparticles to impart special properties

RG/2011/NANO/01

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### INTRODUCTION

An aqueous polyurethane system was developed and it has been end-capped with ene groups to facilitate UV curing. Stability of the Polyurethane Dispersion (PUD) produced was studied in detail.

Dispersion properties such as particle size and stability were studied.

In addition, properties such as thermal, IR, crystallinity and photo properties of films produced were studied.

### PROJECT ACHIEVEMENTS

In this project, we produced a water based polyurethane dispersion that can be used as a coating. The polyurethane films produced show special fluorescence properties. It has been found that fluorescence property can be made reversible. Hence, the possibility of using it as a sensor material would be studied in future. Nano-iron composites of the polyurethane were produced and fluorescence properties were investigated. The polyurethane produced were capped with ene-end groups to impart UV curing characteristics.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Water based polyurethanes are the current trend in the industry albeit information on production or the synthesis of water based polyurethane is not available in Sri Lanka. Hence, the acquiring of the basic chemistry of manufacture of this material is very valuable. Beside the economic value, if one can manufacture this material in Sri Lanka, it will be a very environmental friendly VOC free product. In addition, as we have observed, there is an immense potential in this novel material to be developed as a sensor.

## **FOLLOW-UP**

The possibility of using the reversible fluorescent properties as a sensor is investigated. Mechanism for the reversible fluorescent property is suggested and another project is initiated to use a theoretical approach to support the mechanism proposed.

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## Development of a cost effective method to analyze degraded DNA evidence in Sri Lankan case work

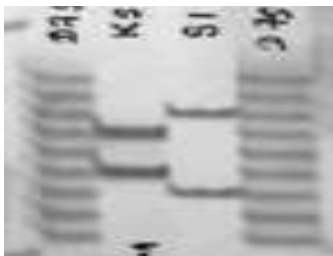
RG/2011/BT/07

### Principal Investigator:

Dr. Ruwan J. Illeperuma

### Co-Investigator:

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Silver stained polyacrylamide gel with amplified PCR products and size makers (ladders) for human mini-STR loci D7S820.

Eight more loci were incorporated to this type of a detection system.

### INTRODUCTION

Miniaturized DNA fragment (mini-STR) techniques in forensic human identification are highly successful for degraded biological samples. However analysis of such smaller DNA fragments demand highly expensive instrumentation and test kits. An in-house method which is validated against commercial test kits was established with significant reduction of analysis cost.

### PROJECT ACHIEVEMENTS

The overall outcome of the project directly contributes to reduce cost and increase sensitivity of analysis of decomposed biological samples in forensic investigations. Training of junior scientists on novel cost effective methods of DNA testing is also an important output. This project marked the establishment of the first validated method to analyze human mini-STRs in Sri Lanka.



## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Capabilities to analyze degraded DNA evidence at a lower cost make this service affordable to the investigators of crime. Maintaining the affordability is vital for sustenance of novel techniques. The cost reduction of the new method is 77% net per sample of which directly benefits the government of Sri Lanka. Entire testing procedure does not require expensive automated instrumentations thus saving a significant amount of initial capital.

## **FOLLOW-UP**

A case report was published in 2014 demonstrating the success of applying the novel testing procedure on degraded biological samples. It is planned to determine the success rate of the new system empirically by evaluating future applications of this technique on diverse array of degraded biological samples in detail.

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## Glycolipid formulations for stabilization of bioactive compounds and microemulsion formation

RG/2011/BS/02

### Principal Investigator:

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Perera

### Co-Investigator:

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Department of Chemistry  
University of Peradeniya

### INTRODUCTION

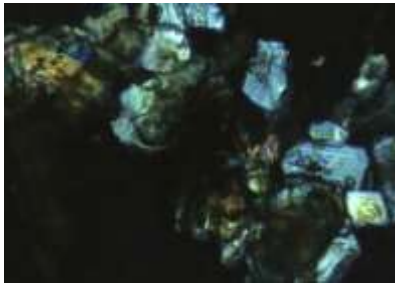
The research project looks at stabilizing microemulsions using glycolipids. The glycolipid hexadecyl- $\beta$ -D-glucopyranoside, was synthesized from glucose and hexadecanol. The liquid crystalline properties of the glycolipid was studied. Microemulsions containing drugs such as diclofenac sodium and natural products like  $\beta$ -carotene were evaluated for effect of glycolipid on the skin permeability.

### PROJECT ACHIEVEMENTS

Lyotropic and thermotropic properties of the hexadecyl- $\beta$ -D-glucopyranoside were observed. The glycolipid improved the skin permeability of both diclofenac sodium and carotene as determined by a pig ear model.



Ternary phase diagram for emulsion formation



## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Sri Lanka has a consumer oriented economy where many of the products are a form of emulsion. Studies of emulsion properties is an important part in stability. Stability determines the quality of the product and as such the studies performed are important in many of the industries.



Lyotropic texture in water

## FOLLOW-UP

Glycolipids have many applications in industry. However, carbohydrate liquid crystals have limited applications due to their low melting temperatures and small range. However, they are good surfactants and their use in applications requiring surfactants should be investigated.



Lyotropic texture in acetone

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# Investigating the effect of cowpea (*Vigna unguiculata*) on the accumulation of visceral fat mass and oxidative status using animal experimental model

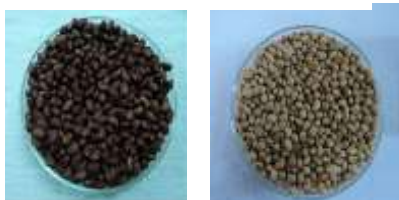
RG/2011/AG/09

## Principal Investigator:

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## Co-Investigators:

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University of Peradeniya  
Dr. Barana Jayawardana  
Department of Food Science  
University of Peradeniya



Picture of Waruni and MI35 cowpeas

## INTRODUCTION

In this study, the effect of whole cowpea powder on the serum lipids, glucose, antioxidant activity, and cecal fermentation was investigated in Wistar rats. From findings it was observed that Waruni cowpea is the best of all studied cowpeas in lowering serum lipids and glucose in Wistar rats.

## PROJECT ACHIEVEMENTS

Waruni, Bombay and MI35 cowpea cultivar incorporated experimental diets significantly reduced serum LDL cholesterol in Wistar rats. From all the findings it could be speculated that Waruni cowpea is the best of all studied cowpeas in lowering serum lipids and glucose. The hypocholesterolemic and hypoglycemic effect of cowpea were supported by higher fecal weight, higher cecal weight, higher cecal *Lactobacilli* population and higher serum antioxidant activity in rats. Based on the findings consumption of cowpea could be recommended to improve the serum lipids and glucose.



Blood lipid analysis using plate reader



Analyzing microbial population in caecal content

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

There is a high prevalence of non-communicable diseases in Sri Lanka at present. Thus, promoting cereal based diets such as cowpea may save millions of rupees spent on imported cereals as well as reduce the health cost and increase the wellbeing of the people in Sri Lanka. Further, promoting cowpea consumption may increase the economic value of the cowpea and increase the income of the poor farmers.

## FOLLOW-UP

Further studies will be conducted to investigate the effect of different processing methods on *in vivo* lipid and glucose modulation ability of cowpeas. Findings will be disseminated to general public through newspaper articles to promote the consumption of cowpea.

***For more details, contact:***

Dr. Ruvini Liyanage

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# Development of basic techniques for Nanoencapsulation of bioactive compounds

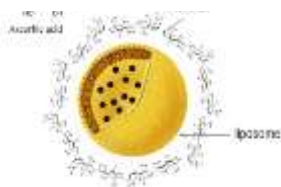
RG /2010/NANO/04

**Principal Investigator:**

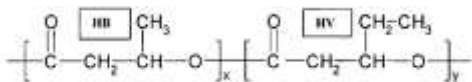
Prof. D. N. Karunaratne.

**Co-Investigator:**

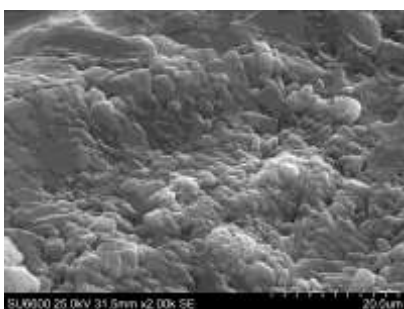
Prof. Veranja Karunaratne  
Department of Chemistry  
University of Peradeniya



Ascorbic acid encapsulated,  
chitosan coated liposome



PHBV -(poly(3-hydroxybutyrate -  
co-3-hydroxyvalerate)



SEM image of amoxicillin  
encapsulated chitosan particles

**For more details, contact:**

Prof. D.N. Karunaratne  
E-mail: nedrak@pdn.ac.lk

**INTRODUCTION**

Nanoencapsulation is a means of imparting improved properties such as enhanced solubility, bioavailability, reduced toxicity and targetability. Nanoparticles of chitosan, alginate and poly (3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) were prepared by ionotropic gelation, precipitation coacervation and for PHBV, double emulsion technique with spraying. Known bioactive compounds- ascorbic acid, folic acid, amoxicillin and curcumin were encapsulated and release studied.

**PROJECT ACHIEVEMENTS**

Developed various techniques for nanoparticle formation.

This project has played a key role in developing the PI’s laboratory in the area of drug delivery, nanoparticle formation and liposome formation. Found that PHBV is a good candidate for prolonged release.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Drug delivery may be considered as a hot area in countries with pharma industries. One of these systems for slow release of amoxicillin revealed that it would be a good candidate for further development. Since antibiotics are required in large amounts, the smallest contribution would make a large impact on our pharmaceutical needs.

**FOLLOW-UP**

This work has allowed further research in this area to grow. Since this was the first attempt at encapsulation in the nanoscale, research with dual drug delivery, and applications towards cancer therapy are now ongoing with the delivery systems experimented here. Further development of carrier systems is also another area that is being developed.

## Population genetic structure analysis of *Penaeus monodon* (Fabricius, 1798) in Sri Lanka

RG/2010/BT/02

### Principal Investigator:

Dr. D.H.N. Munasinghe  
Department of Zoology  
University of Ruhuna



A picture of tiger prawn  
*Penaeus monodon*

### INTRODUCTION

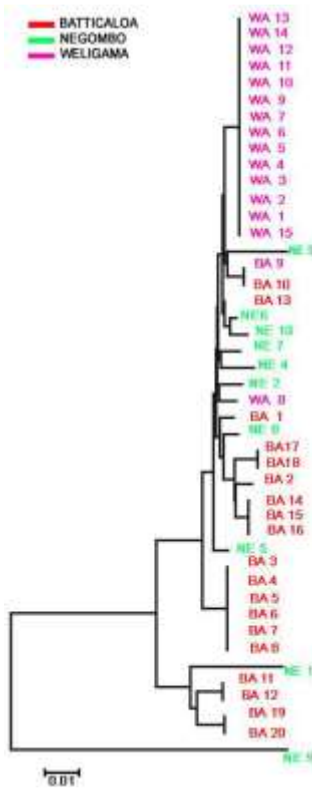
The wild stocks of tiger shrimp, *Penaeus monodon* depleted to an unsustainable level due to many factors including overexploitation. Moreover, the tiger shrimp aquaculture industry still relies on wild-caught brood stocks to seed farmed shrimp populations. Therefore, the origin of brood stocks and their genetic composition are significant issues that require attention. It is important to conduct aquaculture programs with the knowledge of genotypic background of the cultured species. Thus, it is necessary to screen the genetic diversity of the wild populations before collecting brood stocks for culturing programs as well as to maintain the genetic diversity levels of the wild populations. Therefore, this study was conducted to investigate the pattern of genetic diversity among three *P. monodon* populations in Sri Lanka using molecular data.

### PROJECT ACHIEVEMENTS

Results of the current study indicated that: Genetically diverged *P. monodon* populations are available in eastern, western and southern regions of Sri Lanka. High genetic variation was observed in eastern and western populations while southern population shows low genetic variation. Sri Lankan populations are genetically more closely related with the western Pacific Ocean populations (Thailand, Taiwan, Vietnam etc.) than western Indian Ocean populations (Madagascar, Mauritius, Tanzania etc.). Specific haplotypes were recorded from Sri Lankan populations. Genetic information of wild populations of *P. monodon* have been published in genbank and contributed to the future studies of field.



Gel image of SSCP analyses for western population (each vertical lane represent an individual)



Phylogenetic relationship of haplotypes recorded from three populations

Batticaloa – Eastern region  
 Negombo – Western Region  
 Weligama – Southern region

**For more details, contact:**

Dr. D.H.N. Munasinghe  
 E-mail: dhn@zoo.ruh.ac.lk

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The ultimate target of the aquaculture industry is profit which could be gained through a quality yield. Therefore, In culturing programs, genetically diverged brood stock need to be maintained to produce offspring with high growth rates and resistant to diseases. On the other hand, when artificial recruitment is necessary for ongoing culturing programs, appropriate individuals could be selected from the wild populations when genetic information is available and documented.

According to the results of this study, in a broad scale it can be suggested that Sri Lankan populations are genetically more closely related with the western Pacific Ocean populations (Thailand, Thaiwan, Vietnam etc.) than western Indian Ocean populations (Madagascar, Mauritius, Tanzania etc.). Such information could be considered if importing livestock of *P. monodon* for culture purposes. Information arising from this study could be considered when selecting brood stocks for culturing programs.

Routine monitoring programs are necessary to maintain population genetic structure of the wild populations which can be affected through factors such as over exploitation, pollution and climate changes.

**FOLLOW-UP**

Collection and documentation of genetic data of geographically separated populations are important in production of new varieties, such as ‘genetically improved tiger prawn varieties’. In such occasions, genetically different forms could be utilized to conduct experiments in order to select the best variety.





# Investigating plant responses to changing atmospheric carbon dioxide with special emphasis on anatomical and physiological adaptations of stomata in different ecotypes across a range of altitudes

RG/2010/BS/01

## Principal Investigator:

Dr. S. W. Ranwala  
University of Colombo

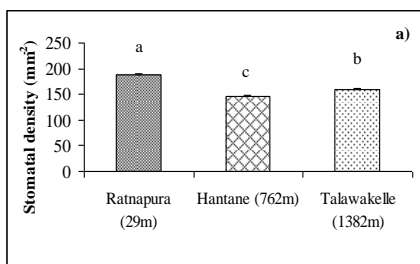
## Co-Investigators:

Dr. H. I. U. Caldera  
University of Colombo

Prof. W. A. J. M. De Costa  
University of Peradeniya

## INTRODUCTION

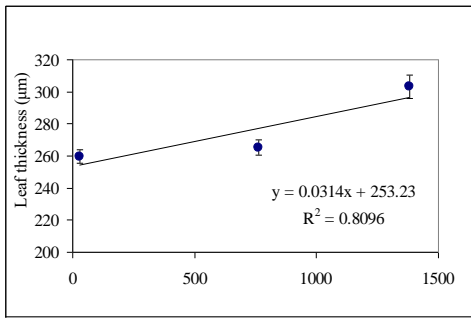
The study focused on the response of stomata to environmental gradients. This included identifying and determining a cultivar based variation in *Camellia sinensis* across an altitudinal range and determining the impact of soil water stress; determining the stomatal, anatomical and physiological responses of *C. sinensis* and *Arabidopsis thaliana* ecotypes to elevated atmospheric [CO<sub>2</sub>] and elevated temperature.



Variation of leaf thickness of *C. sinensis* cultivars across an altitudinal gradient.

## PROJECT ACHIEVEMENTS

The *C. sinensis* showed a cultivar based response to altitude in their stomatal numbers and dimensions, though stomatal size was a more conserved trait. Leaf thickness increased with altitude and cultivars sampled at the lowest altitude showed the highest palisade: spongy parenchyma ratio. Elevated CO<sub>2</sub> increased the net photosynthetic rate and leaf thickness in *C. sinensis* but stomatal conductance decreased by 25%. In *A. thaliana* ecotypes stomatal size was not as plastic in response to elevated CO<sub>2</sub> and temperature.



Variation of stomatal density of *C. sinensis* cultivars across an

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The tea industry is a major source of foreign income and provides direct and indirect employment to a large number of individuals. Future climate change may affect tea plantations and therefore, timely research is required to determine the response of tea plants to possible changes in the future environment. The stomatal and anatomical traits reported here would be useful to develop cultivars suited to varied environments and to recommend suitable cultivars under future climate change conditions.

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## Development and characterization of functional textile materials with stain-resistant and antimicrobial activities

RG/2009/NANO/01

**Principal Investigator:**

Prof. R.M.G. Rajapakse  
Department of Chemistry  
University of Peradeniya

**Co-Investigator:**

Dr. Sanath Rajapakse  
Department of Molecular  
Biology and Biotechnology  
University of Peradeniya

### INTRODUCTION

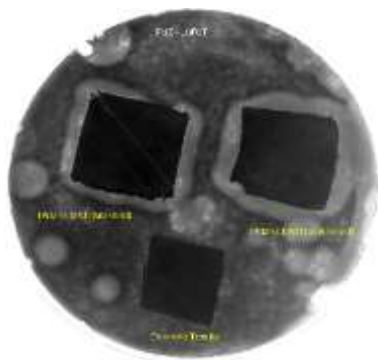
This project is concerned with the development of synthetic methods to prepare colloidal nanoparticles of titanium dioxide, zinc oxide, silver and silver oxide, covalent attachment of these nanoparticles onto textile materials and to study antimicrobial and superhydrophobic activities of modified textile materials. These materials may be tested for antibacterial and antifungal activities and for contact angle and roll off angle measurements.



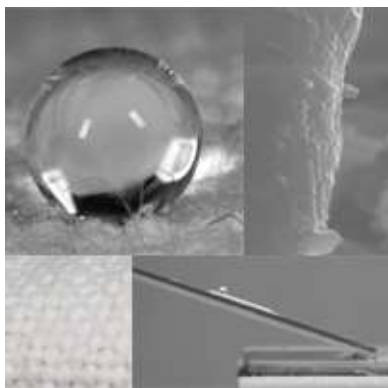
Colours of cotton surfaces modified by different sized silver nanoparticles

### PROJECT ACHIEVEMENTS

Procedures were developed to covalently attach nano particles of  $\text{TiO}_2$ ,  $\text{ZnO}$  and  $\text{Ag}$  on cotton surfaces and the resulting materials were found to have excellent antibacterial properties (for *Escherichia coli*, *Staphylococcus aureus* and MRSA) and antifungal properties for *Aspergillus niger* fungal colonies. A hierarchical structure of the lotus leaf was developed on  $\text{ZnO}$  nano particle-bound cotton surfaces by introducing stearic acid by self-assembly and impressive contact and roll-off angles for water-droplets were obtained.



Antimicrobial activity of  $\text{TiO}_2$  and  $\text{ZnO}$  padded cotton against *P. aeruginosa* on blood agar plate



Measurement of contact and roll off angles of water droplets on super hydrophobic cotton. An SEM image of  $\text{ZnO}$  particle attached cotton is also shown.

**For more details, contact:**  
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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The antimicrobial textiles developed here may be used as wound disinfecting dressings, odourless garments such as socks and underwear and as self-disinfecting cloths particularly for those to be worn in operating theatres and intensive care units. New garments which do not require frequent washings may be developed. These advanced textile materials may be introduced to already existing Sri Lankan garment industries to produce high quality advanced garments for export.

## FOLLOW-UP

Collaboration was made with the "Intelligent Glove Solutions", a leading advanced glove producing company situated in the Free Trade Zone, Katunayake, to develop antistatic and antimicrobial gloves for the export market. A research assistant funded by the company is pursuing research studies to develop such gloves.

## Development of recombinant proteins as diagnostic intermediates for Chikungunya (CHIK), dengue and leptospirosis infections

RG/2009/BT/01

**Principal Investigator:**

Dr. Menaka Hapugoda  
Molecular Medicine Unit  
Faculty of Medicine  
University of Kelaniya  
Ragama

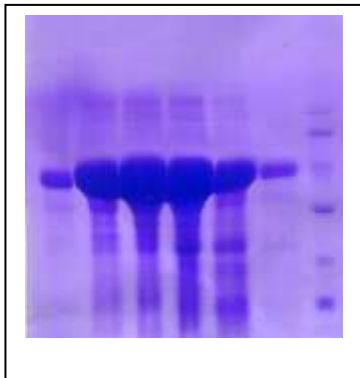


Fig. 1. 12% SDS PAGE gel showing the purified chikungunya protein: under denative conditions

### INTRODUCTION

Confirmation of chikungunya, dengue and leptospirosis outbreaks is important for proper management of patients. Enzyme-Linked Immunosorbent Assay (ELISA) can be used for confirmation of these diseases. Development of a diagnostic intermediate for each disease which can detect both IgM and IgG antibodies in ELISA, produced at low cost and easily standardized for use in field settings is important.

### PROJECT ACHIEVEMENTS

Availability of diagnostic intermediates and assays for chikungunya, dengue and leptospirosis. Establishment of collaborative networks at national and international levels.

Dissemination project results through provision of project results to health authority for patient management.



Fig 2. Preparation of recombinant protein antigens



Fig 3. Preparation of clinical samples for ELISA

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## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Target group beneficiaries would be the infected people and healthy persons in outbreak area/s of these three diseases by confirming each disease using ELISAs developed using these recombinant protein antigens. This type of study on development of diagnostic intermediates have a significant effect for rapid confirmation of outbreaks and limit spread of such outbreaks from one geographical area to another. Further, confirmation of disease outbreaks, could avoid losing productive working hours and socio-economical impact on individuals and government.

## **FOLLOW-UP**

Possibility of obtaining patents for novel recombinant protein antigens will be examined.



# Chemistry and bioactivity of endemic plant genus *Schumacheria*

RG/2009/BS/01

**Principal Investigator:**

Prof. A. Wickramasinghe

**Co-Investigators:**

Prof. Veranja Karunaratne

Prof. B.M. Ratnayake Bandara

Department of Chemistry

University of Peradeniya



Broad leaves and white  
inflorescence of *S. castaneifolia*

## INTRODUCTION

The research study was planned to evaluate and harness the chemical and the pharmaceutical potential of endemic genus *Schumacheria* belonging to the family Dilleniaceae.

The chemistry and the bioactivity of three species of the endemic genus *Schumacheria* namely, *S. castaneifolia*, *S. angustifolia* and *S. alnifolia* are described. Hexane, methanol and dichloromethane extracts of the plant parts of *Schumacheria* were subjected to, antioxidant assay using DPPH (1,1-diphenyl-2-picrylhydrazine) stable radical, cytotoxic assay using brine shrimps (*Artemia salina*) and antimicrobial assays against *Staphylococcus aureus* (NCTC 8532), *Escherichia coli* (NCTC 10418) and *Aspergillus niger*.

The extracts of different plant parts of *Schumacheria* were subjected to several chromatographic fractionations and fifteen compounds were isolated. The structure elucidation and the bioactivity determinations were carried out

## PROJECT ACHIEVEMENTS

Species of *Schumacheria* was found to have several betulinic acid, oleanolic acid derivatives, phytosteroid, flavonoids and polyphenols. The amounts of betulinic acid derivatives present in all three species of *Schumacheria* are relatively high (0.2 % to the dry weight of the plant parts).

The methanol extracts of plant parts of *Schumacheria* contained high antioxidant activity and high polyphenol content. Chemical composition of the *S. alnifolia* and *S. angustifolia* is similar but deviated from the chemical composition of *S. castaneifolia*. The isolation of oleanilic acid derivative and 3-O- $\alpha$ -L-arabinosyl oleanolic acid in all three species of *Schumacheria* showed its close relationship with the genus *Dillenia*. The morphological and DNA fingerprinting study confirmed the presence of three distinct species of *Schumacheria*: *S. castaneifolia*, *S. angustifolia* and *S. alnifolia* in Sri Lanka.



Dark green oblong leaves and small white inflorescence of *S. alnifolia*



Small leaves of *S. angustifolia*

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The betulinic acid derivative 6 $\beta$ -hydroxy-3-oxolup-20(29)-en-28-oic acid isolated from the *S. castaneifolia* and its bioactivities may related to the structure activity relationship among the betulinic acid derivatives to identify proper drug leads to treat leukemia, prostate cancer and for other diseases caused by viruses.

*Schumacheria* plants can be commercially cultivated for the purpose of industrial scale of extraction of medicinally important bioactive betulinic acid derivatives

## FOLLOW-UP

The betulinic acid derivative 6 $\beta$ -hydroxy-3-oxolup-20(29)-en-28-oic acid showed considerable antibacterial activity, most of these betulinic acid derivatives known to have high antileukemic activity and antiviral activity. The evaluation of antileukemic and antiviral activity of the 6 $\beta$ -hydroxy-3-oxolup-20(29)-en-28-oic acid is of importance.

3-O- $\alpha$ -L-Arabinosyloleanolic acid showed cytotoxic activity against brine shrimps (LC<sub>50</sub> = 7.6  $\pm$  0.6 ppm). However, this and other isolated compounds need to be evaluated using cancer cell lines.

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# Preliminary investigations on the ecology and the phylogenetic relationships of coronaviruses of Sri Lankan bats

RG/2008/EB/03

**Principal Investigator:**

Prof. Wipula Bandara Yapa  
Department of Zoology  
University of Colombo

**Co- Investigator:**

Prof. J.S.M. Peiris  
Chair Professor  
Department of Microbiology  
The University of Hong Kong

## INTRODUCTION

Severe Acute Respiratory Syndrome (SARS) has been described as a, serious, readily transmissible disease to emerge in the 21st century. Although the origin of the etiological agent of the SARS coronavirus remains to be elusive, bats are suspected to be natural hosts of coronaviruses closely related to those responsible for the SARS outbreak. As no surveillance of coronaviruses has been reported from South Asia, a preliminary surveillance of coronaviruses in several Sri Lankan bat species was undertaken , in this study .

## PROJECT ACHIEVEMENTS

For the first time in Sri Lanka, we have recorded two coronaviruses and 14 astroviruses from Sri Lankan bats were recorded Both coronaviruses were detected from *Miniopterus schreiberssi*, which were most similar to HKU8 and bat CoV 1 detected from *Miniopterus* bats in Hong Kong suggesting these virus groups are host-genus specific.

Astroviruses have so far been reported only from insectivorous bats in Hong Kong and Mainland China. A new astrovirus from a fruit eating bat, *Rousettus leschenaulti* in Sri Lanka, which clustered among the astrovirus recorded from other major groups of mammals and has shown a unique relationship to typical human astroviruses. This is a significant finding as astroviruses have previously been recorded from other species of bats, but did not show such close relationships to other groups of mammals.



*Rousettus leschenaulti*



*Miniopterus schreiberssi*

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The findings of novel coronaviruses and astroviruses in bats in Sri Lanka provide information on the ecology of these viruses in bats in the country. In Sri Lanka, large areas of natural habitats are converted to agricultural lands forcing surviving bat populations to concentrate on the remaining patches of forests or in the modified ecosystems. When these patches are used for shade or feeding grounds for domesticated animals such as cattle and buffalos, food remnants, chewed by bats (insect as well as fruits) may find their way into human food chain thus paving the way for progression of SARS in Sri Lanka.

## FOLLOW-UP

The results suggest that the astroviruses carried by fruit bats are closely related to previously known astroviruses detected in other mammals including humans. There has to be a source for astroviruses in these groups of mammals, including humans, and this finding of an astrovirus on top of the phylogenetic tree, necessitates to verify whether bats, specially *R. leschenaulti* are the reservoir for astroviruses in mammals. Further virological investigations on bats will provide a more complete picture on the ecology of astroviruses.

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## Equilibrium studies on toxic metal ion-mixed ligand systems under physiological conditions

RG/2008/BS/01

**Principal Investigator:**

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Department of Chemistry  
Faculty of Science  
University of Peradeniya

**Co- Investigator:**

Prof. O. A. Ileperuma  
Department of Chemistry  
Faculty of Science  
University of Peradeniya

**INTRODUCTION**

Pb (II), Cd (II), Al (III) are toxic metals as they do not have any biological role in living systems. Further, Cu (II) in excess can be toxic to people. The main focus of this study was the investigation of interactions between these metals and mixed ligand systems entering into our body frequently through food and common drugs.

**PROJECT ACHIEVEMENTS**

Determined the complex species available for each system at different pH values and elucidated their structures in solutions. The stability constants of each binary and ternary complexes available at pH values for each system were determined and best chelating agents for each toxic metal for metal oxidation were found. The harmful aspects and biological effects of therapeutic activity when taking drugs and natural chelators together by a metal intoxicated person were identified. Effectiveness of the use of natural chelators for chelation therapy over EDTA was compared.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

With the acceleration in industrialization, urbanization and excessive usage of pesticides and other toxic chemicals, the metal toxicity has been increased recently among Sri Lankans. Hence it is important to keep them informed about the interactions among those metals and common drugs purchased over the counter and chelators in dietary substances to prevent the accumulation of toxic metals in the body and to keep the people healthy.

## **FOLLOW-UP**

As this project reveals many important aspects on toxic metal-mixed ligand interactions under *in-vitro* conditions, these interactions would help for more effective and less harmful chelation therapy through mixed ligand systems. Thus, this project can be extended in collaboration with the Faculty of Medicine to study how much clinically these mixed systems are effective in chelation therapy.

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## Further investigation of the anticancer activity of a herbal medicine used in Sri Lanka

Fellow/2008/01

### Principal Investigator:

Prof. M. I. Thabrew  
Honorary Professor

### Co-Investigators:

Prof. K. H. Tennekoon  
Institute of Biochemistry  
Molecular Biology &  
Biotechnology (IBMBB)  
University of Colombo

### INTRODUCTION

Decoction (DC) and ethanolic extract (EE) of *Nigella sativa* (seeds), *Hemidesmus indicus* (roots), and *Smilax glabra* (rhizome) were standardized. Antihepatocarcinogenic effects of DC reported previously *in vivo*, were confirmed *in vitro* by investigation of cytotoxicity of DC and EE to human hepatoma (HepG2) cells and effects on expression of two key genes (p53 and NF- $\kappa$ B) associated with carcinogenesis, in above cells.

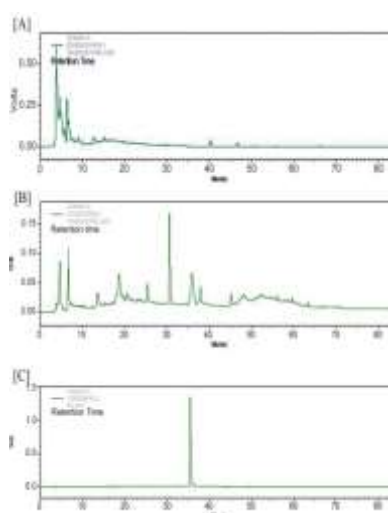


Figure 1: HPLC profiles of [A] decoction, [B] ethanolic extract, [C] Thymoquinone, active anti-carcinogenic compound isolated from *N. sativa* seeds (Thymoquinone is not present in the decoction.)

### PROJECT ACHIEVEMENTS

Decoction (DC) and ethanolic extract (EE) were standardized according to W.H.O. guidelines. On evaluation of effects cell morphology and cell activity (by MTT and SRB assays), both DC and EE were shown to mediate comparable cytotoxicity to HepG2 cells (Fig.2). However, the EE demonstrated high cytotoxicity to non-cancerous cells (M RC-5) also. Compounds other than Thymoquinone appear to mediate cytotoxicity of DC (Fig. 1).

Up-regulation of p53 activity accompanied by down-regulation of NF- $\kappa$ B activity in HepG2 cells by the DC suggests that it may mediate its reported antihepatocarcinogenic effects at least in part, through modulating activities of genes involved in tumour suppression and tumour promotion.

The results provide a new insight into the possible molecular mechanisms by which the decoction may be of benefit in the therapy of hepatocellular carcinoma.

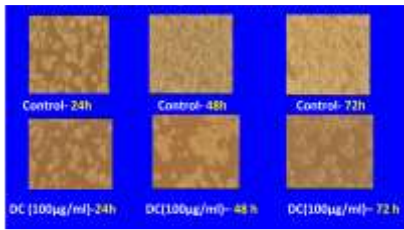


Figure 2: Changes in Hep2 cell proliferation & morphology at 24hrs, 48 hrs and 72 hrs post- incubation with the DC

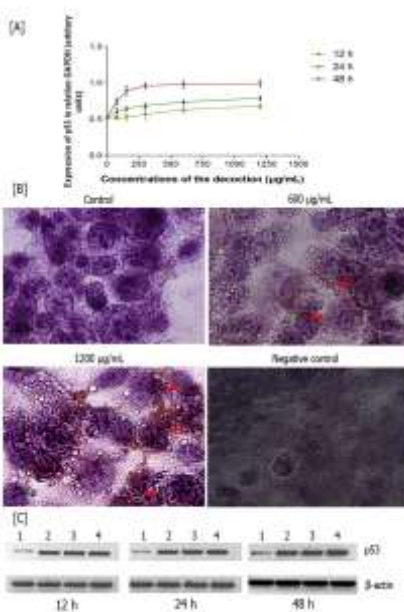


Fig. 3 - Effect of the DC on the expression of p53 evaluated by [A] RT-PCR analysis, [B] Immunohistochemistry (red arrows indicate expressed proteins), and [C] Western blot analysis. Both mRNA and protein levels of p53 were up-regulated.

**For more details, contact:**  
 Prof. M.I. Thabrew  
 E-mail: irathab@hotmail.com

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Primary hepatocellular carcinoma (HCC) is the 3<sup>rd</sup> largest cause of deaths in the world. In Sri Lanka too, there has been a continuing increase in the reported number of HCC patients. Although surgery has helped to reduce mortality to some extent, other therapies such as chemotherapy and radiotherapy have not resulted in the expected reduction in death rates. Further, they produce some very unpleasant side effects. Therefore, there is a continuing search for better control and preventive methods that would not only reduce cancer mortality, but would also have less related side effects. The potential of using natural products as anti-cancer agents was recognized in the 1950's by the US National Cancer Institute, and has since made major contributions to the discovery of new, clinically useful natural compounds with anti-cancer activity. These include vincristine, vinblastine, the camptothecin derivatives, topotecan and irinotecan, etoposide, and paclitaxel (taxol®).

The scientific evidence provided by the present study to confirm the antihepatocarcinogenic potential of a polyherbal remedy that has been used in Sri Lanka for cancer therapy could be exploited further to develop a clinically and globally acceptable drug that could be used alone or in combination with existing therapies for the benefit of HCC patients. This would in the long term, also be of much economic benefit to Sri Lanka.

## FOLLOW-UP

Further investigations have resulted in the identification and isolation of two major active compounds with antihepatocarcinogenic activity. Further studies have also demonstrated that enhancement of apoptosis and cell cycle arrest and inhibition of inflammation are mechanisms through which the DC and its active compounds can mediate anti-hepatocarcinogenic actions.

# Application of Geographic Information System for modeling spatial and temporal risk for dengue transmission in Kelaniya MOH area in Sri Lanka

RG/2007/HS/14

**Principal Investigator:**

Dr. L. D. Amarasinghe  
Department of Zoology  
University of Kelaniya

**Co-Investigators:**

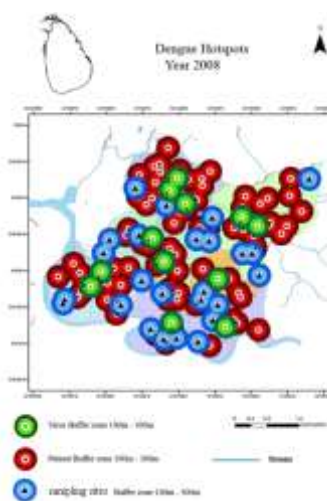
Dr. D. L. Jayaratne  
University of Kelaniya  
Mr. P. H. M. P. K. Senaratne  
Department of Geography  
University of Kelaniya  
Dr. Mahanama Rajamanthre  
Lady Ridgeway Hospital  
Dr. R. Bannahakke  
Lady Ridgeway Hospital

**INTRODUCTION**

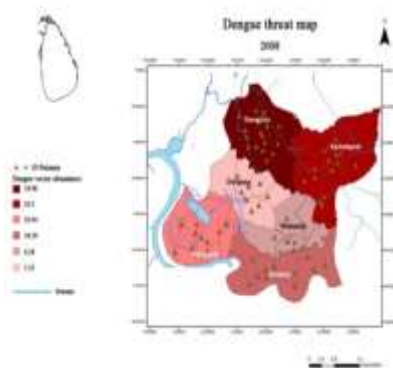
Huge numerical sets of data that runs over temporal and spatial dimensions accumulate with a dengue epidemic and are difficult to handle efficiently to target for immediate action against the disease. Geographic Information Systems (GIS) can be effectively applied to monitor spatial and temporal risk for disease epidemiology and transmission.

**PROJECT ACHIEVEMENTS**

Dengue serotypes, DEN 1 and DEN 3 were circulating in the Kelaniya MOH area as mixed infections in two mosquito species, *Aedes aegypti* and the dominant, *A. albopictus*. There was no vector species specificity in serotype transmission. There was no dominant serotype. Dengue threat maps were created based on vector mosquito abundance. There was a positive correlation between transmission of the disease and permanent and temporary water bodies but that was impossible to predict using climatic data.



Dengue hotspots 2008



Dengue threat map 2008



Dengue threat map 2009

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Number of dengue cases was positively correlated with vector mosquito abundance. High prevalence of *Aedes albopictus* and *A. aegypti* that transmit dengue virus sero-types 1 and 3 determined the dengue high risk areas within Kelaniya MOH area. Socio-cultural factors that were most responsible in transmission of the disease involved poor disposal of waste and prolonged storage of water for domestic and other purposes.

## FOLLOW-UP

This project was completed after preparation of dengue threat maps for localized area within the MOH area of Kelaniya in Sri Lanka. Follow up studies have been planned to investigate vector prevalence within an extended area giving high priority on management of waste disposal and dengue prevalence and subsequent prevention.

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# A study on ovulatory dysfunction in an infertile population of Sri Lanka and a prospective randomized comparison between Clomifene citrate and Letrozole, in ovulation induction and augmentation

RG/2007/HS/08

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## INTRODUCTION

An ovulation is a common cause of infertility and is treated by ovulation induction. Letrozole is a newer therapeutic agent introduced for this indication and is thought to be more favourable than Clomifene citrate. The objective was to compare the two agents for efficacy and safety in ovulation induction and augmentation.

## PROJECT ACHIEVEMENTS

The features associated with Letrozole resistance seemed to be different to those with Clomifene resistance, though there was some overlap noted. While Letrozole was effective in some women with Clomifene resistance, the overall efficacy was not high. However, the endometrium appeared more favourable with the use of Letrozole than with Clomifene, when used for augmentation of ovulation.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Letrozole appears to be more favourable in augmentation of ovulation than Clomifene citrate and seems an alternative to more expensive gonadotropin usage in Clomifene resistance. This will be a useful treatment modality for women who do not respond to Clomifene, in a low resource setting such as Sri Lanka.

## FOLLOW-UP

No follow up studies carried out.



## Evaluation of inflammatory markers and MTHFR 677C-T genotype in women with and without Coronary artery disease (CAD)

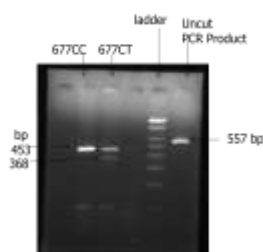
RG/2007/HS/06

**Principal Investigator:**  
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**Co-Investigators:**  
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### INTRODUCTION

Coronary artery disease (CAD) risk in Sri Lankans is not explained by traditional risk factors alone. Thus, investigating non-traditional risk markers such as serum folate, plasma total homocysteine (tHcy) and inflammatory markers; high sensitivity CRP (hs-CRP) and soluble intercellular adhesion molecule-1 (sICAM-1), and methylene tetrahydrofolate reductase (MTHFR) 677C-T genotype for prevention of CAD is pertinent.



PCR-RFLP for MTHFR 677C-T Polymorphism. Photo of agarose gel.

### PROJECT ACHIEVEMENTS

tHcy and sICAM-1 were independently associated with CAD in women. A higher percentage of subjects with MTHFR 677 T allele were in the high tHcy group (plasma tHcy <math>< 9.1 \mu\text{mol/L}</math>). Although nutrition counseling significantly decreased waist circumference, BMI and serum triglyceride in all women, effects on total and LDL cholesterol and folate were significant only in women without CAD, having a low inflammatory status.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The findings of the associations of CAD and new risk factors in focus and the comprehensively designed educational package will be useful in developing and implementing food based strategies for primary and secondary prevention of CAD, especially among women.

The identification of genetic markers in coronary risk in this target population will contribute to the development of a research program in Nutrigenetics, which is an ongoing priority research area in the international arena.

## **FOLLOW-UP**

Nutrition counseling was effective in reducing serum total and LDL cholesterol and increasing serum folate in women without CAD having a “low” baseline inflammatory status. This hindering effect of underlying inflammation, on biochemical response to dietary modification should be further investigated. The findings support the interesting hypothesis that underlying chronic inflammation may lead to vitamin depletion, which perhaps contributes to a sustained chronic inflammatory status warranting further studies.

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# Validation of PCR method for the diagnosis of rickettsial diseases and its application to map the disease for Sri Lanka

RG/2007/HS/04

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**Co-Investigator:**

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**INTRODUCTION**

Mapping of rickettsial disease in Sri Lanka was carried out after validation of an in-house molecular method for the diagnosis of the disease. 23 hospitals representing 8 provinces provided 615 samples from patients with a clinical diagnosis of rickettsioses. Spotted fever rickettsioses was the predominant rickettsioses in patients presenting to Gampola, Nawalapitiya, Peradeniya, Mawanella, Kegalle, Kandy, Matale, Hambantota, Diyatalawa, Badulla and Monaragala hospitals while scrub typhus was predominant in Kuliyaipitiya, Kurunegala, Dambadeniya, Anuradhapura, Trincomalee and Matara. Consistent temporal patterns were seen in Kandy and Kurunegala districts in 2009 and 2010.

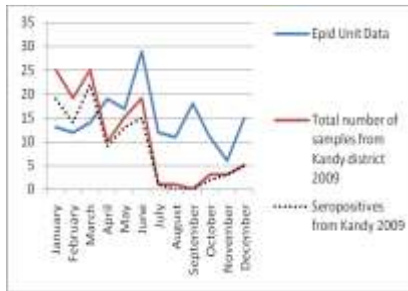


Distribution of spotted fever rickettsioses and scrub typhus –  
spotted fever predominance –  
scrub typhus predominance

**PROJECT ACHIEVEMENTS**

An in - house genus specific PCR was developed and validated for spotted fever rickettsioses and a modification of a published PCR for scrub typhus. Although both PCR’s had good detection limits, it was noted that stringent attention to detail in collection and transport was needed to achieve acceptable results.

This project increases knowledge of the distribution of rickettsioses in Sri Lanka and helped identify practical issues associated with laboratory diagnosis.



Correlation of notification, clinical diagnosis and laboratory confirmation. Also demonstrates temporal variation

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Many infectious diseases take their toll on patients – both health-wise as well as in economic terms such as loss of income, particularly for daily wage earners, loss of schooling and other negative effects. Lack of accurate and reliable diagnosis leads to inappropriate use of antibiotics, prolonged period of ill health and added burden of hospitalization with increase of costs, both to the patient as well as the health care providers.

Very little had been known about the distribution and presentation of rickettsioses in Sri Lanka until recently and the work done in this study has contributed significantly to awareness of the disease which improves early diagnosis and shortens the duration of illness as appropriate antibiotics are started early, rather than late in the illness.

In addition, plotting the distribution of the disease, both geographically as well as temporally has been started and will help focus on areas where further work can be carried out.

## FOLLOW-UP

Currently no further follow up. However, the aetiology of spotted fever rickettsioses, primary host and risk factors require further study to reduce the burden of ill health due to this infectious disease.

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# Hydrothermal synthesis and characterization of pure hydroxyapatite and hydroxyapatite-organic polymer nanocomposites for possible applications in dentistry and in artificial bones

RG/2007/FR/08

**Principal Investigator:**  
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**Co- Investigators:**  
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University of Peradeniya



Custom-made Elbow Prosthesis manufactured for an 11-year old Patient: Designed and manufactured at the Faculty of Engineering, University of Peradeniya

## INTRODUCTION

This project addressed the development of chemical procedures to remove unwanted impurities in Eppawela Apatite to synthesize pure hydroxyapatite, synthesis of hydroxyapatite-polymer nanocomposites, coating of hydroxyapatite on stainless steel prostheses that are used in bone grafting and study of biocompatibility and toxicity of hydroxyapatite-coated stainless steel prostheses.

## PROJECT ACHIEVEMENTS

EDTA-based method was developed to remove iron impurities in Eppawela hydroxyapatite and a heat-treatment procedure was developed to remove fluorine present in Eppawela apatite. Novel procedures were developed to synthesize rod-like and spherical particles of hydroxyapatite in hydroxyapatite-poly (methyl methacrylate) nanocomposites. A coating procedure was developed to prepare hydroxyapatite-coated stainless steel discs. Custom-made prostheses were developed in collaboration with the Orthopaedic Unit of the Teaching Hospital, Peradeniya and the Departments of Civil and Production Engineering.



Fractured Right Hand Elbow of the Patient before the Transplant



The Right Hand of the Patient after Transplanting the Custom-Made Prosthesis

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Bone injuries are very common in Sri Lanka due to road traffic accidents and other causes. It was particularly severe before and during the civil conflict that prevailed in the country. Custom-made prostheses required for transplanting in these patients are prohibitively expensive due to complicated procedures involved in their manufacture. This project has led to the formation of a research group to design, develop and manufacture custom-made prostheses, hydroxyapatite coating on them and to investigate their biocompatibility and toxicity effects.

## FOLLOW-UP

Designing and developing custom-made prostheses is a challenge which involves conversion of CT-Scan and X-Ray data of injured bones into 3-D images and their ultimate transformation into real prostheses. A group named "Bio Chemical Engineering Research Group" was formed consisting of scientists, engineers and orthopaedic surgeons to achieve this goal. Two such custom-made prostheses were manufactured and successfully transplanted. The activities of this research group are continuing.

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# Synthesis of Glycolipids for use as liquid crystals and surfactants

RG /2007/FR/05

## Principal Investigator:

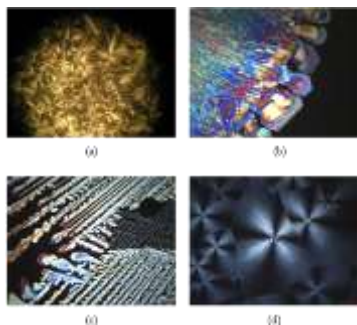
Prof. A.D.L.C. Perera  
Department of Chemistry  
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## Co-Investigator:

Prof. D.N. Karunaratna  
Department of Chemistry  
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## INTRODUCTION

Carbohydrates are easily glycosylated with nonpolar molecules to form amphiphilic derivatives. Such molecules have shown liquid crystalline and surfactant behavior. The glycolipid nature of these molecules makes them useful as membrane builders, surfactants and emulsifiers. They have applications in pharmaceutical, cosmetic and food industries.



Focal conical textures of liquid crystalline compounds synthesized

## PROJECT ACHIEVEMENTS

New compounds were synthesized and characterized. Some compounds synthesized showed thermotropic properties while others had lyotropic properties. The lyotropic liquid crystals had surfactant property.



## **RELEVANCE TO SOCIO-ECONOMIC DEVELOPMENT OF THE COUNTRY**

The ability to produce low cost surfactants would economically benefit food, cosmetic, pharmaceutical, paint and detergent industry. With respect to the national scenario, the cosmetic industry would stand to benefit from the use of these compounds for stabilization and emulsification purposes. Our ongoing research has shown their usefulness in emulsion and liposome stabilization. Further studies on their usefulness as emulsifiers and stabilizers for the pharmaceutical, cosmetic and food industries are ongoing.

## **FOLLOW-UP**

Present status of the research has only shown the applicability of these compounds as promising candidates for surface activity. Application in the cosmetic field as emulsifiers is ongoing and one compound is being tested for drug delivery in micro emulsions. Studies conducted to enhance delivery of cosmoceuticals have shown promising results. Effect of these types of compounds on Liposomal stabilization is being studied.

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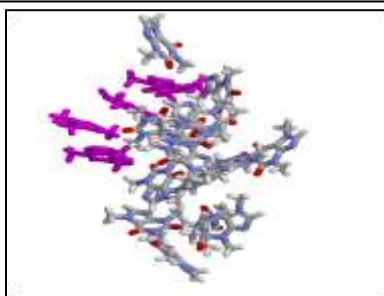


## Investigation of atomic level description of the denaturing agents on hydrophobic interaction by molecular simulation

RG/2007/FR/01

### Principal Investigator:

Dr. Samantha Weerasinghe  
Department of Chemistry  
University of Colombo



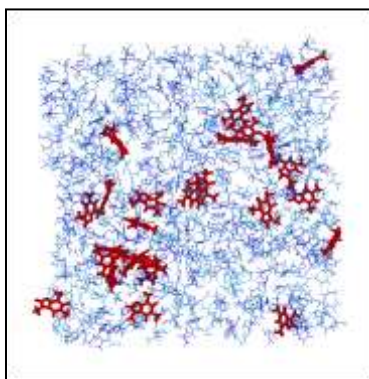
A snap shot of caffeine aggregate taken at the 30<sup>th</sup> ns of the MD trajectory from the simulation of 25 caffeine molecules in water at 300<sup>o</sup>K and 1 bar. Water molecules and the caffeine molecules that were not part of the aggregate were omitted from the figure for clarity

### INTRODUCTION

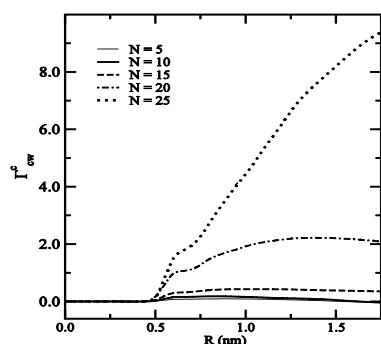
Hydrophobic effect is the tendency of non-polar substances to minimize their interaction with water. This effect can be quantitatively understood as an interaction between hydrophobic moieties to form aggregates. Caffeine form aggregates in aqueous solutions due to hydrophobic interactions. Therefore, caffeine is a good candidate to investigate about formation and dissipation of aggregates.

### PROJECT ACHIEVEMENTS

Development of a molecular mechanics force field for caffeine is the main outcome of this research project. The developed force field has been used to understand the mechanism of aggregation of caffeine in aqueous medium and the role of denaturing agents (urea; in this study) for dissipation of caffeine aggregates. The results strengthen the hypothesis of entropy driven dissipation of caffeine aggregates by urea.



Final configuration of caffeine in 8M urea after 40 ns of MD simulation that clearly shows the effect of urea on the dissipation of caffeine aggregate



Preferential interaction parameter of caffeine for another caffeine molecule over water molecule, at different caffeine concentrations

## RELEVANCE TO SOCIO-ECONOMIC DEVELOPMENT OF THE COUNTRY

With experience gathered from this research project, the Research Student was able to train more people for these types of computer based studies. The developed molecular mechanics force field for caffeine is being used by researchers in other Research Institutes and Universities to gain more insight into the action of chemical denaturing agents on caffeine aggregates.

## FOLLOW-UP

One Research Student in the Department of Chemistry, IIT Guwahari, India is using the developed caffeine force field for her Ph.D. Research project. Several undergraduate research projects were carried out to understand the effects of caffeine on medicinal compounds. The concentration dependence of urea and guanidinium chloride on the dissipation of caffeine aggregates has been studied.

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# Computer vision for monitoring and controlling vehicular traffic

RG/2007/E/03

## Principal Investigator:

Prof. D. U. J. Sonnadara  
Department of Physics  
University of Colombo



Number plate identification  
and character segmentation



Tracking moving objects for  
speed detection

## INTRODUCTION

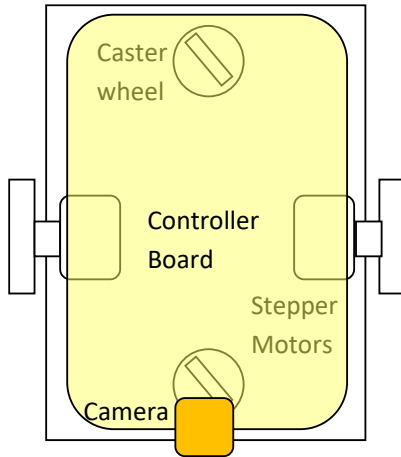
Due to rapid increase in the import of vehicles especially during the recent years and the absence of proper road infrastructure to accommodate the increase, vehicular traffic has become a major problem for many commuters in Sri Lanka. This problem is severe in the commercial capital of Colombo where many of these vehicles will finally reside. Recent increase in the fuel cost, frequent closure of roads due to security reasons and vehicular emissions must be also taken into account when considering the unnecessary delays at the intersections. Thus, it is necessary to find ways and means of optimizing the flow of traffic with the existing physical limitations to save time and money of the commuters.

The main objective of this work is to develop pattern recognition algorithms as well as learning algorithms based on fuzzy logic / neural networks to control vehicle flow at traffic junctions and to test series of techniques based on computer vision that can be utilized in monitoring and controlling the flow of traffic.

## PROJECT ACHIEVEMENTS

The main research work carried out under this project can be summarized into following 5 broad categories: development of an adoptive traffic control system; vehicular speed detection through image processing; traffic detection at intersections; recognition of vehicle number plates; autonomous vehicles.

The results showed that techniques based on computer vision can be used successfully to identify, extract and control parameters related to vehicular traffic. It can also be concluded that optical flow can be used to avoid obstacles in autonomous robot navigation.



Developed autonomous robot

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The following contributions are made through this project towards scientific advancement: Development of algorithms required to implement neuro-fuzzy signal control systems at 4 way traffic junctions and pedestrian crossings; Testing and developing algorithms for speed detection of vehicles through image processing; Detection and classification of traffic including night time detection and extending to extracting of traffic parameters at junctions; Automatic recognition of number plates of vehicles specific to Sri Lankan standards; Development of an autonomous robot.

The results of this project are useful for our understanding of implementing automated traffic control and identification systems for city planners.

## FOLLOW-UP

With the knowledge gained, two projects in the area of computer vision applied to solving local industry problems (coir fibre industry and apparels industry) were initiated and promising results have already been obtained.

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## Soil carbon sequestration and greenhouse gas emissions from paddy and forest ecosystems in Sri Lanka

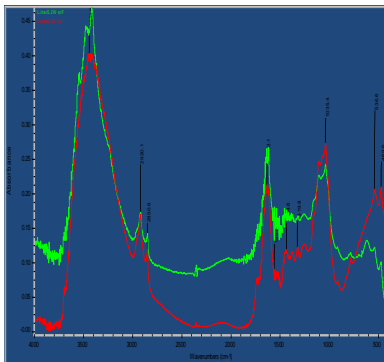
RG/2007/EB/05

### Principal Investigator:

Dr. G. Seneviratne  
Microbial Biotechnology Unit  
National Institute of  
Fundamental Studies  
Kandy

### Co-Is:

Dr. L.A.W. Liyanaarachchi  
National Institute of  
Fundamental Studies  
Dr. S. P. Indraratne  
University of Peradeniya



FTIR spectra of the greenhouse gases analysed

### INTRODUCTION

Study was conducted to investigate soil carbon sequestration and greenhouse gas (GHG) emission in paddy fields in dry and wet zones and a forest in the dry zone. Emissions of GHG in relation to soil carbohydrates, nitrogen and soil aggregate stability, and also effect of carbohydrates on aggregate stability were evaluated.

### PROJECT ACHIEVEMENTS

The study showed that the forest contained larger carbon and nitrogen pools than the paddy field in the dry zone. Out of all sites, the highest carbon sequestration and nitrogen accumulation were found in the wet zone paddy field that had relatively low soil CO<sub>2</sub> emission. The forest showed a high soil aggregate stability due to high carbohydrate content. Soil carbohydrate controlled aggregate stability only after a critical level of carbohydrates in the forest.



Soil profile with organic horizon of the wet zone paddy field



Maize cobs with BFBFs + 50% of chemical fertilizers (left), and only 100% of chemical fertilizers (right)

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## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Carbon sequestration in forest and agroecosystems is considered to be an important factor in mitigating climatic change. Paddy fields in the wet zone appear to be potential agroecosystems for carbon sequestration and trading. They are also important in mitigating GHG emission and atmospheric warming. The sequestered carbon in the paddy fields is also important in sustaining soil fertility that affects agricultural productivity.

## **FOLLOW-UP**

At present, studies in various agroecosystems using microbial formulations known as biofilmed biofertilizers (BFBFs) are being conducted, in order to enhance soil fertility and carbon sequestration, and also to mitigate GHG emissions and atmospheric warming. Up to now, the above under field experimental conditions in tea, rice and maize cultivations with reduced chemical fertilizer inputs to 50%, coupled with the BFBFs, but without affecting yields of the crops have been achieved. In maize, the BFBFs increased yield over 100% of chemical fertilizers.



## Diversity and community composition of worker ants collected from selected habitats in four Districts in the dry and intermediate zones and the implementation of a database on ants of Sri Lanka

RG/2007/EB/03

### Principal Investigator:

Prof. R. K. S. Dias

Department of Zoology  
University of Kelaniya

### INTRODUCTION

A survey on worker ants was carried out in selected forests, uncultivated lands and cultivated lands, in Anuradhapura (dry zone), Polonnaruwa (dry zone), Puttalam (arid zone) and Kurunegala (intermediate zone), by employing multiple sampling methods.

A preparation of a database of ants of Sri Lanka was undertaken under this research project.



A site at Panirendawa Forest in  
Puttalam District

### PROJECT ACHIEVEMENTS

Multiple methods resulted in a higher ant species richness than any single method. Eight subfamilies, 31 genera and 66 ant species were recorded from Anuradhapura lands and 07, 26 and 52 of those, respectively were observed in Polonnaruwa lands. Six subfamilies, 25 genera and 56 species from Puttalam lands and 08, 29 and 63 of those, respectively from Kurunegala lands were recorded. Ten subfamilies, 40 genera and 99 species were recorded from the 36 lands.

A website on “Ants of Sri Lanka” was launched ([www.kln.ac.lk/science/web](http://www.kln.ac.lk/science/web)).





Worker ants of Sri Lanka were poorly known earlier but recent surveys (2000 - 2012) in more than 50 lands have resulted in a database



Workers of *Stereomyrmex horni* were recorded after 100 years

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Improved ant inventories of Anuradhapura and Polonnaruwa lands and the preliminary inventories of Puttalam and Kurunagala lands will serve as the basis for future listing of ants in the four districts.

Website on “Ants of Sri Lanka” will serve as a quick reference guide for the identification of ants as well as for other important information of the ants.

**FOLLOW-UP**

Continuous updating of website; Identification of ants that cause problems in many parts of Sri Lanka; Assistance given to undergraduates (for their research projects) of other universities to identify ants in their collections; Dry mounted ant collection is maintained at the Department of Zoology, University of Kelaniya.



## Taxonomy, distribution and prevalence of tick species associated with human otoacariasis in Sri Lanka

RG/2007/EB/01

**Principal Investigator:**

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### INTRODUCTION

Attachment of a tick or mite to the external ear canal is known as otoacariasis. Otoacariasis is a common condition in livestock and domestic animals. Although rarely seen in humans, it may lead to serious health conditions. Ticks from patients attending ENT clinics in five government hospitals (Kandy, Ratnapura, Nuwara Eliya, Anuradhapura and Kurunegala) were collected.

Nymphal stage of *Dermacentor auratus*, the most common tick species associated with human otoacariasis in Sri Lanka

### PROJECT ACHIEVEMENTS

*Dermacentor auratus* was the most common tick species associated with human otoacariasis in Sri Lanka and is distributed in all five districts. Middle aged women and children were identified as high risk groups.



Four other lesser important tick species causing human otoacariasis

a) *Rhipicephalus sanguineus*

b) *Haemaphysalis bispinosa*

c) *Hyalomma isaaci* and

d) *Otobius megnini*

All are nymphs.



*Dermacentor auratus* collected from the ear canal of a 51 year old female from Kandy district showed an unusual phenomenon of ecdysis while it is inside the ear canal attached to the host. Dorsal view of the adult tick with the sloughed off cuticle of nymph

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Of the five districts studied Kandy, followed by Ratnapura had the highest prevalence of otoacariasis and Nuwara Eliya recorded the least number of cases. Main risk factors identified were involvement of outdoor activities and presence of wildlife around the house while presence of pets and/or livestock was not a risk factor of otoacariasis. These findings can help physicians to develop more focused health awareness programmes, to educate the public on prevention of tick bites.

## FOLLOW-UP

A detailed study on tick infestations and otoacariasis of humans, domestic animals and livestock is in progress. Diversity, distribution and lifecycle of tick species and the role of ticks as vectors carrying infectious agents will be investigated. Special emphasis will be on intra aural tick infestations of horses in Nuwara Eliya race courses and patient follow-up studies in Kandy and Anuradhapura Districts.

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## Light regulated development in plants – translational research in rice (*Oryza sativa*)

RG/2007/BT/09

### Principal Investigator:

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University of Colombo



Transgenic Bg 250 plant on rooting media

### INTRODUCTION

Light is one of the most important factors that regulate plant growth and development. *Arabidopsis* STH2 protein can activate light dependent transcription and positively regulate light mediated development of plants. It has shown, the productivity of crop plants might be enhanced by over-expressing central regulators of light signaling pathway. This study was undertaken to improve the quality and productivity of Bg 250 and Bg 360 indica rice varieties by transforming *Arabidopsis* STH2 gene via *Agrobacterium* mediated transformation method.

### PROJECT ACHIEVEMENTS

*Agrobacterium* mediated rice transformation protocol was standardized using pCAMBIA 1303 plant binary vector. Bg 250 rice were transformed with pPZP-STH2 construct following the above succeeded protocol. Transgenic Bg250 plants showed increased plant height, leaf length, leaf area and bushy appearance due to increased number of tillers when compared with its non transgenic plants. These results demonstrated *Arabidopsis* STH2 gene in Bg 250 rice variety has considerable potential to modulate the rice plant architecture.



Bg 250 transgenic plant on soil

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Agriculture is one of the main contributors of economic development of Sri Lanka and large masses of people make their livelihood from agriculture. The development of transgenic plants with higher yield would definitely meet the growing needs of the population. This will help to alleviate poverty and lead to economic development and undoubtedly will improve well-being of the people.

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# 18s rRNA/rDNA based molecular characterization of locally isolated *Aspergillus oryzae* and the elucidation of alpha amylase gene expression based altered carbohydrate metabolism during fermentation

RG/2007/BT/06

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**Co-Investigator:**

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## INTRODUCTION

An indigenous *Aspergillus oryzae* has been isolated in Sri Lanka which showed high performances in saccharification of high amylose rice starch. The commercialization of the indigenous strain requires well characterization and differentiation from other available commercial strains. For this purpose, characterization of the tested local strain was performed by using rDNA and ITS-1 region and proteome analysis of extracellular proteins secreted on solid state rice medium.

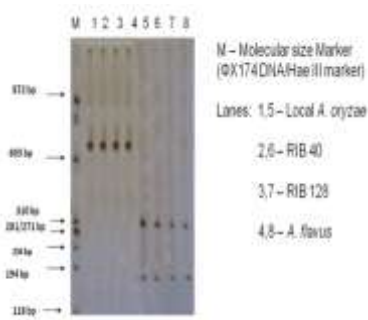
## PROJECT ACHIEVEMENTS

Characterization of the tested local strain was performed by using 18SrDNA and ITS-1 region with specific primers followed by sequencing and PCR-RFLP analysis. However, the attempts were not successful as there was no polymorphism in PCR-RFLP and a very high similarity (96%) in DNA sequence of the tested region.

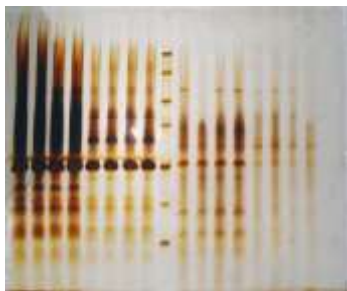
However, the bioassay and the comparative proteome analysis of extracellular proteins confirmed the higher saccharification efficiency of the local strain. The local strain showed high efficiency in secretion of alpha-amylase and glucoamylase B which are the major saccharification enzymes. Apart from them, the extracellular protein profile of the local strain was different from that of the standard strain RIB 40.



Microscopic observations of the conidiophores of *A. oryzae* local strain



PCR amplification of 18s rDNA and ITS-1 region (lanes 1-4) & PCR-RFLP products with restriction enzyme *Hae* III (lanes 4-8) under polyacrylamide gel electrophoresis



SDS-PAGE of extracellular protein profiles of *Aspergillus* strains after 48 hours of growth

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The commercialization of a fungal strain requires well characterization and differentiation from other available commercial strains. However identification of *A. oryzae* is difficult since there are intra-species similarities in *A. oryzae* and morphological similarities of *A. oryzae* with *A. flavus*. Eventhough, rDNA characterization was not successful, this study proved that the local strain is different from the standard strains analyzed. Therefore, together with further studies, the tested local strain could be introduced to the industries as a new strain with altered saccharification efficiency.

## FOLLOW-UP

Since rDNA characterization was not successful, further studies are being carried out on DNA fingerprinting of the local strain using Random Amplified Polymorphic DNA.

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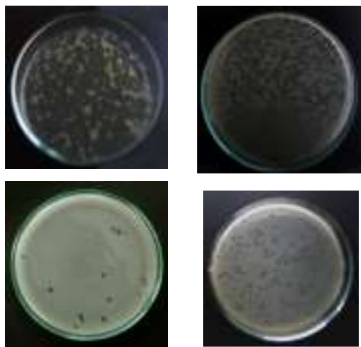


# Control of tomato bacterial wilt caused by *Ralstonia solanacearum* (*Pseudomonas solanacearum*) using bacteriophages

RG/2007/BT/05

## Principal Investigator:

Dr. Devika M. De Costa  
Department of Agricultural  
Biology  
Faculty of Agriculture  
University of Peradeniya



Bacteriophage with different plaque morphologies isolated from different soil samples



Planthouse experiments conducted to determine effective methods of application of bacteriophage

## INTRODUCTION

Control of bacterial wilt of tomato, caused by *Ralstonia solanacearum* has been less effective by chemical and cultural methods and less durable through host plant resistance. The present study attempted a biological control approach as a component of integrated management programme using indigenous bacteriophage dwell in soil.

## PROJECT ACHIEVEMENTS

Seven isolates of bacteriophage having single stranded DNA genomes were identified as effective phages against wilt causing pathogen, *in vitro* and *in vivo*. An *In vitro* mass culturing method of bacteriophage was developed using an a virulent *R. solanacearum* isolate as the host which was identified by the present study. Mixture of bacteriophage, having a concentration of  $10^8$ pfu/ml can be applied six times as a soil drench to reduce the rate of wilt development of field-grown tomato. Application of talc for better survival of phages in soil was also identified.





Field experiment conducted to determine the efficiency of bacteriophage application for the control of bacterial wilt

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Bacterial wilt is an unavoidable threat to field- and plant house-grown tomato in all agroecological zones of Sri Lanka. Severe yield losses are experienced when the crop is at the middle of its growth cycle and the damage cannot be compensated. Bacteriophage mixture and the method of application introduced by the present study which is a low-cost and environmentally-safer alternative method, can be incorporated in integrated management programmes to reduce the rate of wilt development under field conditions.

## **FOLLOW-UP**

Future research will be focused on identification of bacteriophages used in the present study by molecular methods or electron microscopy, modification of method of application of bacteriophage to control wilt incidence and to achieve a better control in terms of the rate of wilt development and improve the survival efficiency of phages in the rhizosphere. Moreover, potential use of the selected bacteriophage in controlling bacterial wilt of other solanaceous crops will be attempted.

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# Determination of Drug (Rifampicin)-Resistant Gene Mutations among Rifampicin Resistant Strains of *Mycobacterium tuberculosis*

RG/2007/BT/03

**Principal Investigator:**

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Dean  
Faculty of Medicine  
University of Colombo

**Co-Investigator:**

Prof. W. S. Sulochana  
Wijesundera  
Department of Biochemistry  
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Faculty of Medicine  
University of Colombo

**INTRODUCTION**

The research comprised of several aspects of rifampicin resistant *Mycobacterium tuberculosis* (MTB) in Sri Lanka including establishment of rapid culture based drug susceptibility testing methods, analysis of *rpoB* gene mutations, development of a novel molecular based rifampicin resistant determination method which is suitable for low resource settings and transmission pattern of resistant strains.

**PROJECT ACHIVEMENTS**

The novel findings of the study expanded the scientific knowledge about rifampicin resistance of MTB which is very important in molecular diagnosis of drug resistance. Evaluated culture based methods and developed DAN probe based method are highly sensitive and specific methods for determination of rifampicin resistance in tuberculosis. Presently, Manual MGIT which is evaluated as a part of the research is used in the routine diagnosis of tuberculosis at the Department of Microbiology, Faculty of Medicine, University of Colombo.

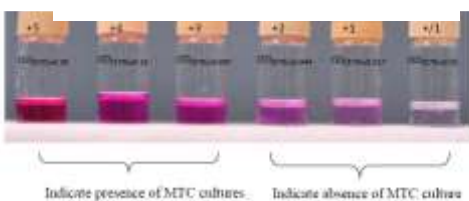


Figure 1: Nitrate reductase assay



Figure 2: *Mycobacterium tuberculosis* cultures grown on L-J medium



Figure 3: Manual MGIT testing

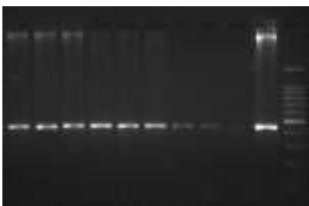


Figure 4: Agarose gel electrophoresis

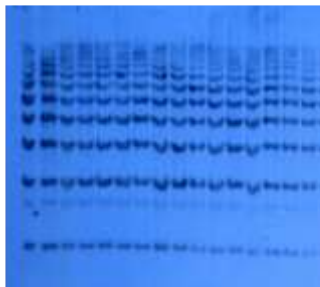


Figure 5: Restriction fragment Length  
Polymorphism (RFLP) analysis

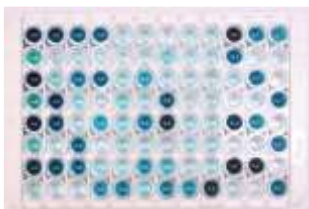


Figure 6: DNA probe based assay

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The solid culture based diagnosis of tuberculosis takes at least 56 days. But the evaluated manual MGIT method takes only 14 days for this purpose. Further, novel findings of the study was a strong evidence for the limitations of applications of commercially available molecular drug susceptibility testing in Sri Lanka. This establishments and findings prevent prolonged inappropriate treatment would cause serious complications in patients as well as spreading of MDR-TB. The cost of treatment per TB patient is very high. Also, People in productive age are more affected by TB and it will reduce their contribution to the economy of the country. Thus, the delaying of diagnosis of drug resistance will lead to several complications in society and the economy of the country. Therefore, this study is highly relevant in the current context of diagnosing tuberculosis in Sri Lanka.

## FOLLOW-UP

Molecular characterization of isoniazid resistant MTB strains in Sri Lanka (next part of this research) is being conducted presently. Establishment and evaluation of a DNA probe based method for detection of multidrug resistant tuberculosis which is suitable to our setting will be the ultimate goal of these studies.



# Nutrient release pattern and effect of decomposition of *Lantana camara* L. (Gandapana) leaf residues on microbial populations of paddy soil

RG /2007/AG/05

**Principal Investigator:**

Dr. S. M. W. Ranwala  
Department of Plant  
Sciences  
Faculty of Science  
University of Colombo

**Co-Investigator:**

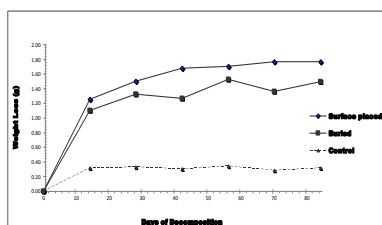
Mrs. L. R. Attigala  
Department of Plant  
Sciences  
Faculty of Science  
University of Colombo

**INTRODUCTION**

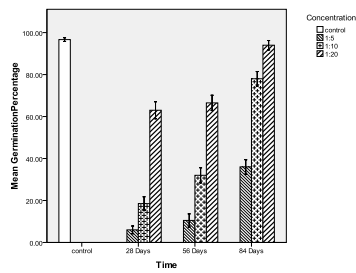
Previous studies (including NSF grant RG/2005/AG/06) have shown that dried residues of *Lantana camara* L. (Gandapana) can be used to enrich soil nutrients while suppressing weeds in the neighborhood. As the diversity and abundance of soil biota, including microorganisms are influenced by decomposing plant residues, this study investigated the followings: The resident time of *Lantana* residues in wet zone paddy field soil; The pattern of nutrient release of *Lantana* residues and how it contributes to the nutrient pool of soil; Any adverse or beneficial effects of *Lantana* compound/s on microbial community of the paddy soil.

Results of the present study showed that the rate of decomposition of surface placed residues was significantly faster than the buried samples.

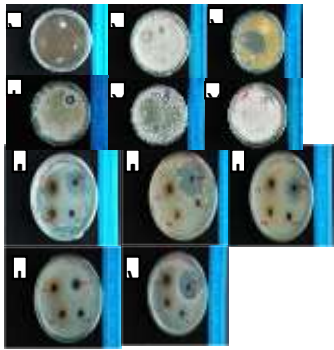
In addition, release of nutrients, such as Potassium, Magnesium, Calcium and Total Organic Carbon (TOC) of *L. camara* residues buried in paddy soil was greater compared with the surface placed sample residues. The results of the bioassay, suggests the phytotoxic strength of *L. camara* residues placed on surface were lower than the buried samples and during decomposition time, the germination and seedling growth of lettuce seeds were markedly increased, indicating a dilution of the toxic effect of *L. camara* residues with time. There were no harmful effects on the isolated soil microorganisms and on few known soil microorganisms with *L. camara* extract from the non-decomposed samples.



Weight loss of *L. camara* leaf residues during decomposition in paddy soil



Germination inhibition of Lettuce seeds by different concentrations of *L. camara* extracts prepared from residues of different decomposition time intervals



*Lantana camara* extracts did not show any inhibitory effects on paddy soil bacteria ( I-V) and fungi ( VI- XI)

**For more details, contact:**

Dr. S. M. W. Ranwala

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## PROJECT ACHIEVEMENTS

The present work was a continuation of previous grant RG/2005/AG/06 which was focused on investigation of the phytotoxicity of *Lantana camara* on germination and growth of rice field weeds. Findings of this study have been summarized into a research paper and submitted to a peer reviewed research journal for publication. The work also provided an opportunity for a graduate student to enhance research capabilities in ecology and microbiology fields.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Research output has shown the potential to develop an organic fertilizer for paddy using plant litter from farmers' surroundings including troublesome invaders in Sri Lanka. Such approach would directly assist the paddy growers to minimize the usage of agrochemicals while encouraging them to produce a healthier harvest.

## FOLLOW-UP

Preliminary findings of this study have led to more investigations towards developing an organic fertilizer for paddy in wet zone soil. Further investigations have proven that mixed litter residues (including *L. camara*) would be better. Their effect on vegetative and reproductive growth on some early yielding varieties is being conducted both at glass house conditions as well as in field conditions.

## Development of an integrated nutrient management system for export agricultural crops by increasing the nutrient uptake efficiency using Mycorrhizal associations

RG/2007/AG/01

### Principal Investigator:

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Director (Research)  
Inter Cropping & Betel  
Research Station  
Department of Export  
Agriculture  
Dampellassa  
Narammala

### Co-Investigators:

Mr. P. R. Idamekorala  
Department of Export  
Agriculture  
Dampellassa  
Narammala



Stained cinnamon root after  
4 months of inoculation

### INTRODUCTION

True cinnamon (*Cinnomomum verum* Presl Syn. *Cinnomomum zeylanicum* Blume) and black pepper (*Piper nigrum* L.) are important Export Agricultural Crops (EACs). Existing inorganic fertilizer recommendations of EACs are based on classical inorganic fertilizers compounds. Therefore, a set of experiments were carried out at the EAC Research Station with the aim of developing arbuscular mycorrhizae (AM) inoculation protocol for black pepper and cinnamon as a bio-fertilizer.

### PROJECT ACHIEVEMENTS

A novel staining procedure for AM structures in roots of cinnamon seedlings was established. Incorporation of the AM inoculum (comprised of c.795 spores plus host crop roots and fungal structures in a moist soil medium) into the potting medium of black pepper rooted cutting was successful.

An improvement in seedling growth and P absorption from Eppawala Rock Phosphate fertilizer (ERP™) with AM inoculation was observed for each black pepper rooted cutting as well as cinnamon seedlings. The effectiveness of native AM isolates for inoculation of black pepper rooted cuttings was also established.



Modified technique for mono-spore culturing of native (local) AM isolates



Spores of native AM (*Glomus*) isolated from Wattapola - Kandyan home garden



AM structures on successfully inoculated black pepper root

**For more details, contact:**

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The potential of reducing the first-year dose of ERP™ recommendation by 50% for black pepper was found. Moreover, the perfection of AM inoculation technique at nursery stage would be a complimentary bonus for organic-based spice farmers as well as other organic agriculturists. Application of AM inocula along with ERP™ is an accepted norm for plant nutrient management and plant health of organic farming. The socio economic benefits of the findings of this project can be considered in terms of the possible reduction in inorganic chemical fertilizer usage considering the supplementary effect of AM utilization would indirectly reduce non-point source environmental pollution of agricultural lands.

## FOLLOW-UP

Isolated native AM spores were further evaluated for effectiveness using black pepper at different P levels and one AM isolate (DEA-AMS1) was released as a bio-fertilizer agent for black pepper. Native AM isolate “DEA-AMS1 is being regenerated at laboratory as well as at one departmental production nursery.

Moreover, DEA-AMS1 is being used as one of the bio-fertilizer agents for NSF project on “Use of microorganisms to improve solubility of phosphate fertilizer” RG/2011/AG/06 at Plant Science Department of University of Colombo in collaboration with DEA Research Division.

## Use of locally available fatty acids and their derivatives as a plasticizer/stabilizer for PVC

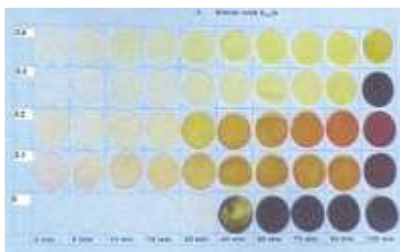
RG/2006/FR/03

**Principal Investigator:**

Prof. L. Karunanayake  
Department of Chemistry  
University of Sri  
Jayewardenepura

**Co- Investigator:**

Prof. G. M. K. B. Gunaherath  
Department of Chemistry  
Open University of Sri Lanka



Variation of colour during the aging at 177°C

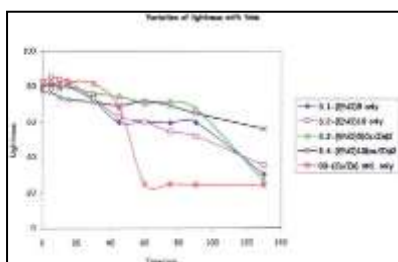
### INTRODUCTION

Plasticizers and stabilizers are essential ingredients used in the manufacture of flexible PVC products. An attempt was made to utilize three different vegetable oils namely Rubber seed oil, Neem oil and Mee oil, in PVC formulations and to understand the behaviour of novel oil derivatives in PVC matrix.

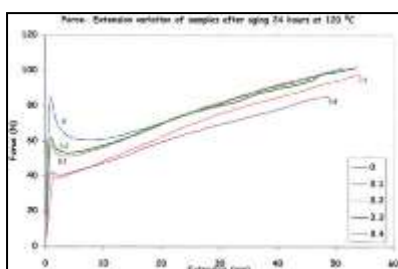
### PROJECT ACHIEVEMENTS

The study revealed that 100% epoxidised oil derivatives were better in performance in their plasticising action. The two oil derivatives, completely epoxidised Neem oil (ENO) and completely epoxidised Mee oil (EMO), were found to be the best in their plasticizing act. ENO was found to be an effective retarder of the degradation of PVC; use of 10 phr level of ENO showed the least degradation with the highest activation energy. The influences of plasticizer % in PVC matrix, polarity of the recipient polymer and cross link density of the latter on migration behaviour of PVC plasticised with ENO were quantified.





Variation of lightness during the aging at 177°C



Force extension variation after aging at 120 °C for 24 h

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

PVC is a commodity polymer used in the industry to make unplasticized and plasticized PVC. Hence, large amount of foreign currency is spent on additives used in the industry. The findings of this study show ways to use some locally available materials to replace imported materials. As these natural materials have to be processed to incorporate in the PVC formulation, there is a possibility for a new industry to manufacture novel additives.

## FOLLOW-UP

The possibility of extending findings into other polymers was investigated.

# Durability properties of earth buildings

RG/2006/E/01

**Principal Investigator:**

Prof. Chintha Jayasinghe  
Department of Civil  
Engineering  
University of Moratuwa

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## INTRODUCTION

The popularization of alternative building materials is viewed as an essential part of improving the sustainability. Earth as an alternative walling material has been the focus of this study. Durability aspects of stabilized earth were studied in detail with a comprehensive experimental programme and a questionnaire survey to identify durability problems and to propose improvements of durability.

## PROJECT ACHIEVEMENTS

As an outcome of this research, the cement content of 5% can be established as the minimum recommended stabilizer content for strength and durability requirement of earth buildings.

A range of surface finishes were selected and subjected to accelerated erosion test and other standard tests. As a result, a set of surface coatings were recommended for earth buildings.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This research drastically improved the confidence of using stabilized earth. Although the strength of earth buildings was proven with past research, durability testing and improvements were established under this research. Hence stabilized earth can be used in building projects, which will improve the green building and sustainable construction in the country.

## FOLLOW-UP

The findings are used in real projects and also in further research carried out to promote green building concepts in Sri Lanka. Research is continuing to develop sustainable solutions for cost effective surface coatings which will be tested using the apparatus fabricated under this project.

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# Application of biomarkers in feral fish to assess seasonal trends and spatial variations in water pollution in two selected water bodies in Sri Lanka

RG/2006/EB/07

## Principal Investigator:

Prof. Asoka Pathiratne  
Department of Zoology  
University of Kelaniya  
Kelaniya



Bathalagoda reservoir

## INTRODUCTION

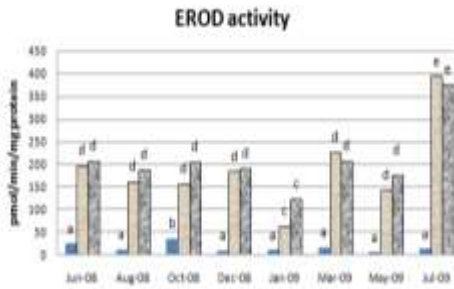
The research aimed at application of multibiomarker responses of feral fish as diagnostic probes for integrated effects of chronic pollutant stress in inland water bodies in Sri Lanka. Seasonal and spatial variations in biomarker responses in feral Nile tilapia were evaluated from two selected water bodies with different degrees of pollution viz. Bolgoda North Lake (an urban water body) and Bathalagoda reservoir (a non urban water body) as model ecosystems to assess the pollutant impacts.

## PROJECT ACHIEVEMENTS

Despite temporal variations, the fish collected from Bolgoda North Lake had significantly elevated ethoxyresorufin-O-deethylase and glutathion-S-transferase and serum sorbitol dehydrogenase activities in comparison with the fish collected from Bathalagoda reservoir. The fish collected from Aththidiya site of Bolgoda North Lake had significantly reduced cholinesterase activities in comparison to the fish collected from Bathalagoda reservoir. Evaluation of multiple biomarker responses of the fish revealed that environmental conditions prevailing in Bathalagoda reservoir do not seem to cause a greater threat to the fish populations inhabiting the reservoir. However the study sites of the Bolgoda North Lake is contaminated with neurotoxic, and hepatotoxic compounds.



Bolgoda North Lake



Strong Induction of hepatic EROD activities of Nile tilapia inhabiting Bolgoda North Lake indicating toxic organic pollutant exposure

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This study was the first systematic long term biomonitoring programme carried out in Sri Lanka to evaluate the biological effects and impacts of aquatic pollutants. The study revealed that fish populations inhabiting Bolgoda North Lake are under threat due to stress caused by complex mixture of pollutants present in the lake. The presence of different types of organic pollutants in Bolgoda North Lake indicate that some of these could be bioconcentrated and/or bioaccumulated in tissues of residing fish, which make the fish unsuitable for human consumption.

## FOLLOW-UP

It is recommended to launch monitoring programs to assess the pollutant loads in fish tissues to determine whether the consumption of fish is safe for humans. As the fish population in Bolgoda North Lake are under threat due to stress caused by complex mixtures of pollutants, immediate remedial measures should be taken to minimize the input of pollutants to the Bolgoda North Lake by the surrounding pollution sources in order to improve the health status of these valuable aquatic resource.

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## Rapid and early detection and molecular serotyping of *Listeria monocytogenes* in milk and milk products

RG/2006/BT/01

### Principal Investigator:

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Department of Mycology  
Medical Research Institute

### Co-Investigators:

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Department of Bacteriology  
Medical Research Institute

Mr. R. Ramesh  
Department of Molecular  
Biology  
Medical Research Institute

### INTRODUCTION

*Listeria monocytogenes* is the causative organism of listeriosis, which primarily affects immune-compromised individuals, including pregnant women. Contamination of milk and milk products with *L. monocytogenes* is a serious problem globally. Even the presence of low numbers of *L. monocytogenes* is a potential risk since this organism is capable of multiplying at ambient and under refrigerated conditions.

### PROJECT ACHIEVEMENTS

The research team was able to modify and standardize the exciting PCR method for the early detection of *L. monocytogenes*.

Using this method *L. monocytogenes* contamination was detected in a variety of dairy products collected from various districts in the country.

Among the detected *L. monocytogenes* strains descending order of predominance is 1/2a, 1/2b and 1/2c. Thus this is the first report on circulating *L. monocytogenes* serotypes in Sri Lanka.

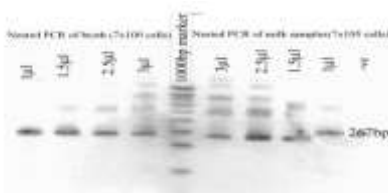


Fig 1: Nested PCR using various amounts of first PCR product



Fig 2: Detection of *L. monocytogenes* pure culture extracts using the nested assay

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

In the dairy industry, continued efforts to control the presence of this pathogen in the production chain are critical to ensure the safety of these products. This study reveals the serotypes of *L. monocytogenes* circulating in Sri Lanka, thus creating awareness among the authorities concerned with public health in Sri Lanka. Further, this study will guide to produce good quality dairy products which are free of *L. monocytogenes*.

## FOLLOW-UP

By using this rapid and early PCR detection MRI can extend their services to the local dairy industries to monitor their manufactured dairy products for *L. monocytogenes* contamination.

The local scientific community is interested in this field could collaborate with the MRI to do further research.

This type of study will be done in human samples thus different serotypes of *Listeria monocytogenes* prevailing in this country can be identified which in turn will help to investigate the molecular epidemiology of the disease listeriosis in the future.

### **For more details, contact:**

Ms. W.A.S. Wijendra

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# Development of low frequency tapping systems to address the tapper shortage and to reduce the cost of production in the rubber industry in Sri Lanka

RG/2006/AG/07

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Rubber Research Institute of  
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Dartonfield  
Agalawatta

**Co-Investigator:**

Ms. K. V. V. S. Kudaligama  
Rubber Research Institute of  
Sri Lanka  
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Agalawatta



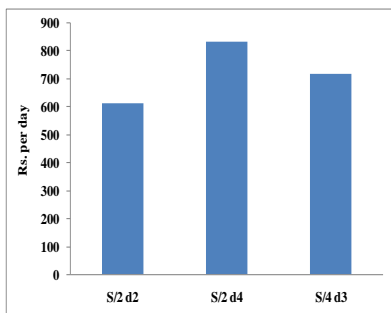
Quarter spiral cut is sufficient to get the required yield

## INTRODUCTION

High production costs, shortage of skilled harvesters and high levels of bark consumption are the key issues associated with latex harvesting in rubber plantations. Difficulty in adopting machinery for latex harvesting demands investigations on Low Intensity Harvesting (LIH) systems to address above issues. Therefore, this study aimed to develop new LIH systems under Sri Lankan conditions.

## PROJECT ACHIEVEMENTS

The study developed two LIH systems, i.e. tapping the tree half spiral once in four days (S/2 d4) and quarter spiral once in three days (S/4 d3) with Ethephon stimulation. These systems bring down the harvester requirement by 50% & 33% and the tapping cost by 23% & 21%, whilst increasing the annual net profit by about Rs.40,000/= and Rs.30,000/= per hectare, harvesters' income by 36% & 18% and tree lifespan by 16 & 30 years, respectively.



Low intensity harvesting provides greater income to latex harvesters



Farmers in the Eastern province are testing low intensity harvesting systems

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Large scale application of project outputs will increase the total rubber production in the country by minimizing the crop loss associated with skilled worker shortage. With increased worker productivity and reduced cost of production, these systems facilitate the rubber industry to compete with other perennial crops. Livelihood of estate workers will be improved with the increase in their remunerations.

## FOLLOW-UP

Arrangements were made to disseminate findings to general public by newspaper articles and through regional and estate level workshops. Large scale adoption in regional plantation companies and testing of oil based Ethephon formulations with these LIH systems are in progress. Since the study was basically done with large estates in the wet areas of the country, a new study began with NSF funding to test the systems in drier areas with smallholder farmers in the Eastern Province.





## Differentiation of Sri Lankan mustard (*Brassica juncea*) varieties and altering their fatty acid profile by inter-specific hybridization with canola (*B. napus*)

RG/2006/AG/04

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The Open University of Sri  
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### Co-Investigators:

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Hantana Road  
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Dr. O. V. D. S. J. Weerasena  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology  
University of Colombo



Rescued embryo (F<sub>1</sub>) of *B. napus* var. Monty x *B. juncea* Accession 7700 in Lichter medium (Lichter, 1982)

### INTRODUCTION

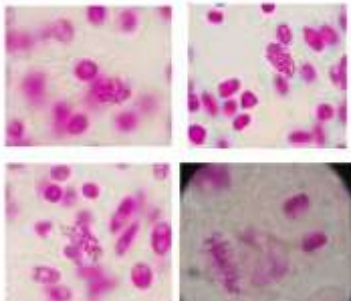
Several mustard (*Brassica juncea*) accessions are available in Sri Lanka. Estimation of genetic diversity is very useful in efficient germplasm collection and management of this crop. Mustard oil has high erucic acid content but it is considerably low in canola quality fatty acids. High levels of erucic acid are associated with undesirable health effects. It is important to substitute local mustards with new lines produced by hybridizing mustard with high quality canola varieties.

### PROJECT ACHIEVEMENTS

Comparison of agro-morphological and molecular data indicated usefulness of molecular markers in estimating genetic diversity among mustard accessions in Sri Lanka with greater accuracy and reliability. Successful inter-specific hybridization of mustard (*B. juncea*-♀) and canola (*B. napus*-♂) is possible. Hybrid F<sub>1</sub> embryos were successfully rescued onto an artificial medium. Fatty acid composition (FAC) of F<sub>1</sub> and F<sub>2</sub> seeds and plants showed a shift towards canola parents. Inter-specific crosses and embryo rescue are a viable method to alter FAC of local *B. juncea* towards canola quality FA profile.



F<sub>1</sub> plant (*B. napus* var. Monty x *B. juncea* Accession 7700) in a test tube



Chromosomes of the F<sub>1</sub> hybrid of *B. napus* var. Monty x *B. juncea* Accession 7700

#### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The new mustard lines produced by inter-specific hybridization between the two species, canola (*B. napus*) and mustard (*B. juncea*) will have canola quality fatty acid profiles. Mustard being a subsistence crop, newly improved mustard lines could be used as an alternative oil seed crop with nutritionally better oil quality for human consumption. The farmers, particularly in the dry and intermediate zones will benefit from this.

#### FOLLOW-UP

Inter-specific crosses between *B. napus* cultivars (♂) and *B. juncea* accessions (♀) gave crossability of 50–65%. Accordingly, hybridization between canola and mustard can be stabilized in a breeding program.

Desirable genes for fatty acid composition can be transferred across the species from *B. napus* to *B. juncea* and stable embryos recovered or rescued *in vitro*. Plants are expected to grow to maturity with an altered canola quality fatty acid profile.

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## Determination of pathotype & genetic variation of rice blast fungus (*Magnaporthe grisea*) isolates in agro-ecological zones in Sri Lanka

SIDA/2006/BT/05

### Principal Investigator:

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Department of Biochemistry &  
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Faculty of Medicine  
University of Colombo

### Co-Investigators:

Ms. Y. J. P. K. Mithrasena  
Regional Agricultural Research  
& Development Centre  
Bombuwela  
Kalutara

### INTRODUCTION

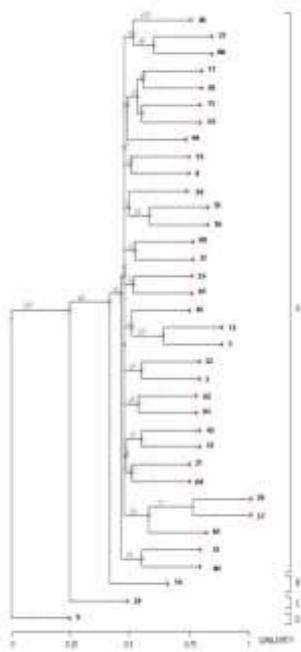
Rice blast disease caused by *Magnaporthe grisea* is among the most devastating diseases of rice in Sri Lanka. Development of blast resistant cultivars is important to establish an economically friendly method of blast management. The study was undertaken to determine the pathogenic and genetic diversity of isolates of *M. grisea* in different agro-ecological zones of Sri Lanka.

### PROJECT ACHIEVEMENTS

Nine pathotypes of rice blast causal organism, *M. grisea* distributed over different agro-ecological zones in Sri Lanka were identified. Pathotype 2 was restricted to the dry zone. It was observed that two popular commonly cultivated rice varieties Bg 358 & Ld 356 were susceptible for all pathotypes studied. Of the 16 rice differential lines, seven lines, had highly effective blast resistance. The DNA fingerprinting analysis revealed a low genetic diversity among isolates.



Locations of rice blast disease samples collected from different districts in Sri Lanka



Dendrogram constructed using unweighted pair group method with arithmetic average (UPGMA) based on pot2 rep-PCR fingerprint data of *Magnaporthe grisea*. Numbers given on the termini of the branches are the *M. grisea* isolate. Majority of the isolates cluster into group A.

**For more details, contact:**  
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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The present study would lead to improve blast resistance of newly developed rice varieties with respect to wide coverage and durability so that grain yield losses due to blast in farmers' fields can be avoided. Thus rice yields at farmer level is expected to increase which will result in retaining farmers in rice cultivation particularly in the Wet Zone leading to improved living standards of farmers and national rice production.

## FOLLOW-UP

The rice varietal screening against blast disease is carried out at present only at Rice Research & Development Institute. Measures could be taken to increase the number of sites of blast screening according to the 09 pathotypes so that varieties that are tolerant to all the pathotypes can be identified in the future rice improvement programs. The seven blast resistance lines can be used in the breeding programmes for development of lines having durable resistance to blast.

## Structural and functional characterization of uncharacterized parasitic nematode specific protein (SDUP) from goat and sheep parasite, *Setaria digitata*

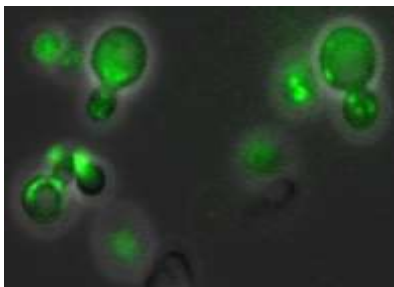
SIDA/2006/BT/04

**Principal Investigator:**

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University of Colombo

**Co-Investigators:**

Dr. S.J. Weerasena  
Prof. E.H. Karunanayake  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology  
University of Colombo



Sub cellular localization of SDUP  
in *P. pastoris*

### INTRODUCTION

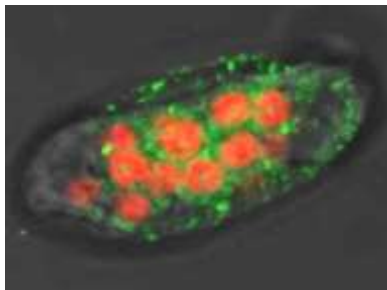
More than one third of the world's populations are infected with parasitic nematodes of which 1.4 billion people are threatened by lymphatic filariasis and 120 million people have already been clinically affected. Therefore, understanding genetics behind parasitism is important. This project details molecular analyses of parasitic nematode-specific gene from *Setaria digitata*.

### PROJECT ACHIEVEMENTS

Genome organization, gene expression at different life stages, Expression of recombinant SDUP (r-SDUP) in bacteria using chaperone mediated solubilization and yeast, *Pichia pastoris*, Purification of r-SDUP, development of antibody against r-SDUP, sub cellular localization using Green fluorescent protein, cellular localization in different life stages using immunohistochemical staining were achieved.



Immunohistochemical staining showing SDUP localization in longitudinal muscles



Embryo showing expression of SDUP

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Research findings published under this project have added new knowledge to the genetics and biology of parasitic nematodes. Scientists, technical staff, undergraduates have been trained on cutting-edge techniques, protein expression and purification, gene expression and protein expression analyses, immunohistaining and cellular protein localization analyses, designing and engineering gene constructs developed in this project. Further, if this protein to be essential for parasite survival, it may help to control parasitic nematode infection in animals and humans.

## FOLLOW-UP

3D structural studies using x-ray crystallographic techniques are currently in progress to understand structure and function relationship. RNA- interference assay and related techniques are being developed to study the role of SDUP in cellular and phenotypical levels. Protein pull-down assay followed by proteomics analysis is undertaken to study interaction of SDUP with other cellular proteins. Kinase assays are set up to study regulatory effect by phosphorylation and dephosphorylation on SDUP.

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# Investigation of dengue virus serotypes and genetic variability in relation to disease severity and transmission

SIDA/2006/BT/02

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University of Kelaniya

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Gunawardene  
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Faculty of Medicine  
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**Co-Investigators:**

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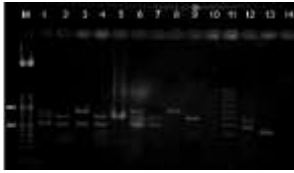
Dr. Aresha Manamperi  
Molecular Medicine Unit  
Faculty of Medicine  
University of Kelaniya

## INTRODUCTION

Dengue virus causes productive cytolitic infections in humans. Morbidity and mortality due to dengue infection has been reported during the last two decades in Sri Lanka. The project details a molecular analysis of Dengue virus serotypes and genetic variability in relation to disease severity and transmission in four endemic geographical regions in Sri Lanka.

## PROJECT ACHIEVEMENTS

Following novel information were generated from this study, in the Sri Lankan context: Co-circulation of more than two serotypes in patients and in different pools of mosquitoes within one district; simultaneous co-infections in patients by two serotypes; Molecular Taxonomical indication that isolates of DEN-2 are more likely to be of an Indian ancestry and the existence of inter district and intra district quasispecies of DEN-2; efficiency of *Ae. albopictus* as a vector in transmitting dengue in the absence or low abundance of *A. aegypti* and unique substitutions present within antigenic regions on E gene in DENV2 and DENV3 in Sri Lanka.



Gel image of positive bands for DEN-2 (Lane-9),DEN-3 (Lanes 8,13),DEN 2-3 (Lanes 2, 4,12) and DEN-3-4 (Lane 3) Co-infections isolated from different geographical locations of Sri Lanka.



Autoradiograph of RT-PCR-LH mosquito pools. Lanes-4,5,8 – Mosquito positive pools for DEN-2 isolated from Gampaha district;

Lane 1: Positive control; Lane 10: negative control.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Research findings published under this project have added new knowledge in diverse areas including epidemiology, clinical management, disease control, virus, human host, and vector factors important for patient management, dengue vector control and future dengue studies in Sri Lanka. Information generated through the study will directly benefit health care institutions and institutions involved in vector control.

## FOLLOW-UP

Information generated from the above study has been used in formulating and conducting several research projects on Dengue infection and related areas such as the projects given below carried out at the Molecular Medicine Unit.

Immunology of infectious diseases: Molecular epidemiology, immune monitoring and the development of a vaccine research platform for Chikungunya; Application of molecular diagnostics in Zoonotic Diseases in Sri Lanka; Multi-country study on Eco-Bio-Social research on dengue in Sri Lanka.

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## Effects of excessive intake of fluoride in people living in endemic areas in Sri Lanka

RG/2005/HS/12

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### Co- Investigators:

Mr. J. P. Padmasiri  
Community Water and  
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Dr. U. S. Usgodaarachchi  
Dr. A. A. H. K. Amarasinghe  
Dental Institute  
Colombo-07

### INTRODUCTION

Health hazards due to excessive ingestion of fluoride are well documented such as dental, soft tissue and skeletal fluorosis. In addition, there is emerging evidence for potential renal damage associated with excessive fluoride intake. Studies have also shown that malnutrition could aggravate fluoride toxicity. The present study was conducted aiming at determining the prevalence and severity of fluorosis in people living in endemic areas, investigating the relationship of nutritional status of people with the occurrence of fluorosis and introduction of a simple defluoridation method and to assess its effectiveness.



Patient examination at a community centre

### PROJECT ACHIEVEMENTS

As revealed from the results the prevalence and severity of dental fluorosis was very high among 12-15 year old children as well as considerably high among 35-44 years-old-adults in the study area. It was found that there was no relationship among nutritional status of people and occurrence of fluorosis. Further, there was no relationship among estimated minimum daily intake of fluoride and occurrence of fluorosis. It was found that the Fluoride filters were deemed an effective and simple defluoridation method for the people who consume excess amounts of fluorides.



Analysing water samples for Fluorides



Fluoride filters

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Dental and skeletal fluorosis caused by excessive ingestion of fluoride is a public health problem. Depositions of excessive fluorides during the period of tooth development give rise to altered tooth structure known as '*dental fluorosis*' which is an irreversible condition. While dental fluorosis can be easily recognized, the skeletal involvement is not clinically obvious as excessive deposition of fluoride on skeletal tissues is a gradual continuing process. With time, affected individuals gradually develop restrictions of movements and stiffness of joints. Treatment for both these conditions needs a considerable amount of resources. The present study would be helpful in developing policies in relation to prevention of these conditions.

## FOLLOW-UP

Short term evaluation and long term evaluation of effectiveness of fluoride filters among recipients was carried out after 6 months and 14 months of the distribution of filters. Overall, fluoride filters were deemed effective as a simple and feasible de-fluoridation method.

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## Study on Phlebotomine Sandflies in selected areas of Sri Lanka

RG/2005/HS/07

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### Co-Investigators:

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Faculty of Medicine  
University of Kelaniya

Prof. N. D. Karunaweera  
Department of Parasitology  
Faculty of Medicine  
University of Colombo



A light trap used to collect adult sandflies

### INTRODUCTION

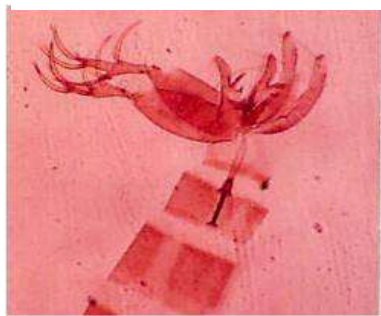
Leishmaniasis is a parasitic disease caused by protozoa that belong to genus *Leishmania*. It is transmitted by an infective bite of vector sandflies. The first indigenous case of cutaneous leishmaniasis was reported in 1992 and the number of cases is increasing at an alarming speed. Therefore an understanding of the probable vectors is important in disease control and prevention in Sri Lanka.

### PROJECT ACHIEVEMENTS

Detailed investigation of sandflies collected from study sites in Sri Lanka revealed the presence of two genera of sandflies: *Phlebotomus* (*P. argentipes*) and *Sergentomyia* (*S. zeylanica*) in selected sites of Kurunegala and Matara districts. *P. argentipes* which is a known vector of leishmaniasis was the dominant species found. The peak aggregation of sandflies within the cattle-traps was between 20.00 to 23.00 hours with highest number appearing between 21 00 hours to 22 00 hours.



A cattle-baited net trap used to collect adult sandflies male



Posterior end of an adult *P. argentipes*



Dissected head of a *S. zeylanica* adult female

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The study was carried out in two different areas with known disease transmission. The dominance by the known vector *P. argentipes* in both areas is an important clue regarding the probable vector. The control activities against the vector could be intensified in these areas. The peak aggregation period is relevant in identification of the active period of vector sandflies. The maximum protective measures should be applied during this period in order to prevent the infective bites.

## FOLLOW-UP

The study was extended to few other areas including sites in Hambantota district where large numbers of cutaneous leishmaniasis patients were reported within a short period. The adult sandflies were collected using cattle baited net traps and light traps. The collected samples were studied for the species distribution, presence of *Leshmania* DNA within the wild-caught female sandflies and blood meal analysis using molecular tools.

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## An assessment on potential health benefits of Sri Lankan black tea (dust grade) by studying its bioactivities

Fellow/2005/01

### Principal Investigator:

Prof. W.D. Ratnasooriya  
Department of Zoology  
Faculty of Science  
University of Colombo

### INTRODUCTION

Sri Lanka is currently the main exporter of Orthodox black tea. Sri Lankan black tea accounts for 20% of the global tea consumption in over 125 countries. Although, health benefits of tea are an increasing global concern, regrettably, those of Sri Lankan black tea are poorly documented. Hence, this study was undertaken to bridge this knowledge gap.



Histopathological evaluation and thrombolytic activity testing

### PROJECT ACHIEVEMENTS

This study for the first time reported that Sri Lankan high grown Dust No.1 black tea possess 18 potential health benefits (anti clotting, thrombolytic, gastroprotective, gastric ulcer healing, anxiolytic, hypoglycaemic, anti-hyperglycaemic, anti diabetic, anti pyretic, antidiarrhoeal, anti-inflammatory, diuretic, hypochloesteromic, anti-hypochloesteromic, LDL cholesterol lowering, antinociceptive, anti-hyperalgesic and aphrodesiac activities) and lack of toxicity with long term consumption.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

As people are concerned about health benefits and toxicities of beverages, the outcome of this project would undoubtedly add value to Sri Lankan Black tea. This would help promote sales of Sri Lankan Black tea, both globally and locally. Further, this study validates Sri Lankan ethnomedicine claims that black tea is useful for some ailments, creating confidence in Sri Lankan traditional medicine. Finally developing a 'tea capsule' as a pharmaceutical and food supplement may be proposed.

## **FOLLOW-UP**

Since composition of phyto-constituents and bio activities of black tea is known to depend on several factors including agro climatic elevation of harvested tea leaves and particle size of manufactured tea, two other studies were initiated to evaluate the bio activities using high grown Broken Orange Pekoe Fannings (BOPF) (Funded by the Tea Board) and low grown Orange Pekoe (OP) grade Black tea (Funded by NSF).

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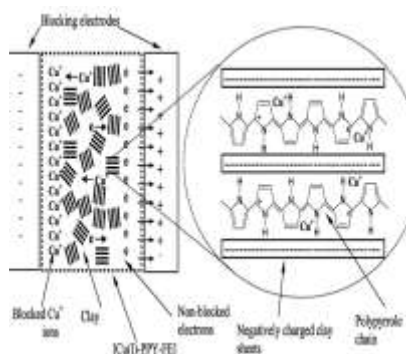


# Clay-polymer nanocomposites: investigation of their electrical, mechanical, thermal and green-catalytic properties for industrial and technological applications

RG/2005/FR/04

**Principal Investigator:**  
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**Co- Investigators:**  
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Prof. D.T.B. Tennakoon  
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Prof. B.M.R. Bandara  
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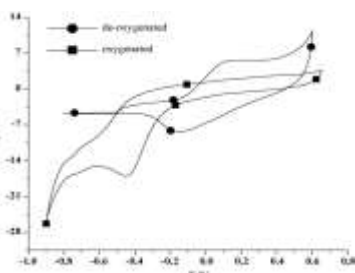
Fast ion conducting behavior of  
Cu(I)-montmorillonite-  
Polypyrrole nanocomposites

## INTRODUCTION

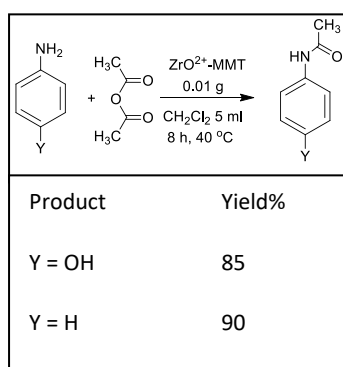
In this project, the cation-exchange characteristics of montmorillonite clay were utilized for the preparation of montmorillonite-conducting polymer-reduced cation type nanocomposites. Polymers with exfoliated clay platelets were used to study the mechanical properties of the nanocomposites. Suitably cation-exchanged montmorillonites were utilized in the green catalytic organic synthesis to synthesize industrially important products.

## PROJECT ACHIEVEMENTS

Procedures were developed to purify montmorillonite clay, exchange interstitial cations for required cations and to prepare clay-polymer nanocomposites. Some nanocomposites are fast ion conductors and some had electro catalytic properties for oxygen reduction. Exfoliated nanocomposites of Poly (acrylonitrile)-montmorillonite and Polyaniline-montmorillonite had superior mechanical and thermal properties. Modified montmorillonites are excellent green catalysts for C-C, C-O and C-N bond formation reactions.



The cyclic voltammetric analysis for [Ce (III)-PPY-MMT] nanocomposite in oxygenated and de-oxygenated electrolytes, demonstrating oxygen reduction ability of the nanocomposite electrode



ZrO<sup>2+</sup>-MMT catalyzed reaction of aromatic amines with acetic anhydride. Reaction conditions are milder for the catalyzed reaction and the yield % is > 85%. The product obtained when Y = OH is paracetamol

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 E-mail: rmgr@pdn.ac.lk

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Fast ion-conductor type clay-polymer nanocomposites may be utilized as electrolytes of batteries. Nanocomposites exhibiting oxygen reduction capabilities may be used to replace expensive platinum catalysts used in fuel cells. Superior mechanical properties of exfoliated clay-polymer nanocomposites may be exploited for the development of motor vehicle parts, impermeable plastic bottles and packaging materials. Green-catalytic organic reactions leading to the synthesis of pharmaceuticals and other industrially important materials may be exploited for the development of new industries.

## FOLLOW-UP

Possibilities for patenting the green-catalytic organic reactions leading to industrially important organic compounds are being exploited.



# Optical and electrical studies in novel solid polymer electrolytes

RG/2005/FR/03

**Principal Investigator:**

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University of Peradeniya

**Co-Investigator:**

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National Institute of  
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Kandy

## INTRODUCTION

Development of solid polymer electrolytes (SPEs) is important for applications in new lithium batteries. Ionic conductivity of SPEs is not sufficient for most practical applications. Under this project, solid polymer electrolytes incorporating lithium salts, alumina nano fillers, and plasticizers to develop new electrolytes with higher ionic conductivity, were synthesized.

## PROJECT ACHIEVEMENTS

Polymer electrolytes with enhanced ionic conductivity were synthesized and characterized.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The new polymer electrolytes developed under this project are environmentally friendly. After going through a R&D phase, these materials can be used to develop new rechargeable batteries.

## FOLLOW-UP

The principal investigator has received a grant from NSF, Sri Lanka to further investigate and develop these polymer electrolytes with fillers from naturally occurring local minerals, such as rutile and ilmenite. Laboratory scale lithium batteries and solar cells can be tested towards the end of this project.

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## Development of extended tools for analyzing data from non-replicated three-way experiments

RG/2005/FR/01

**Principal Investigator:**  
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### INTRODUCTION

The project involved examining 3-way interaction in 3-way experiments in the absence of replication, using “single component” Tucker3 model; in particular, testing rank  $>1$  hypotheses in sub-areas of 3-way data when 3-way interaction is present. This involved improving existing methodology and illustrating the methods using real and simulated data.

### PROJECT ACHIEVEMENTS

Exact critical points, for a likelihood ratio test (LHRT) developed by the principal investigator to identify areas free of 3-way interaction, were generated using a beta approximation with the help of MATLAB®. It worked well for  $3 \times 3 \times 3$ ,  $3 \times 3 \times 4$ ,  $3 \times 3 \times 5$ ,  $3 \times 3 \times 6$ , and  $3 \times 4 \times 4$  cases. Two real data sets were used for illustration. For  $3 \times 3 \times 4$  data set, conclusions were the same as those obtained previously using a convenient alternative. However, this need not be true in general.

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This project is not an application of existing knowledge, but a contribution to new knowledge in the area of data analysis. The extended methodology and software developed in the project for analyzing 3-way experiments in the absence of replication, can be applied to any suitable 3-way data coming from many different areas such as agriculture, biology, education, psychology, chemistry, etc., etc., under certain limitations. As such, it adds to country’s knowledge base and thereby indirectly contributes to its development.

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## Identification, diversity and host plant relations of thrips

RG/2005/EB/05

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University of Peradeniya

### Co-Investigators:

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Department of Botany

Dr. W. A. I. P. Karunaratne  
Department of Zoology  
University of Peradeniya



*Gynaikothrips ficorium*  
damaging leaves of *Ficus bengamina*



Leaf curl in chilli due to  
infestation by *Scirtothrips dorsalis*

### INTRODUCTION

In recent times, thrips have become serious pests of economically important plants through feeding and transmission of viruses. Information on damage, species responsible and host plant relationships is lacking for design of control programs. Over thousand plants in 22 sites covering several habits in nine districts were examined for thrips, in this study.

### PROJECT ACHIEVEMENTS

A checklist of thrips comprising 78 species in 42 genera was published, updating past information since 1913. Study recorded 72 species of thrips in 42 genera on 324 host plant species in 83 families. Among them are 40 pest species previously unrecorded and 20 species and 17 genera new to Sri Lanka. Species identification keys, descriptions of species, damage, host plant records and reference specimen collections are aids in the identification of thrips for control.



Anthurium flower damaged by *Chaetonaphothrips orchidii*

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Since thrips are widespread and attack economic crops that include vegetables, fruits, medicinal plants and ornamentals grown for local and export markets, information gathered on identification of damage and species responsible help to bring in quick control measures using chemicals. Information is used by agriculturists to formulate insecticide recommendations. Occurrence of newly recorded cosmopolitan pest species highlighted the importance of quarantine regulations during import of live plant material and export of ornamentals requiring fumigation procedures.

## FOLLOW-UP

An identification service of pest thrips can be provided. Identification keys developed has been used in teaching special degree students. A reference collection of slide –mounted thrips specimens is deposited in the Department collection for use by other scientists.

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# Determination of mechanical properties and size effects of Sri Lankan timber used in construction

RG/2005/E/07

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University of Peradeniya

## INTRODUCTION

Timber has been used as a construction material for centuries. However, in Sri Lanka, construction is carried out with components that are heavily overdesigned. This study was conducted to determine the true strength of some timber species in Sri Lanka, to develop proper structural design procedures and to explore cost saving techniques in house construction.

## PROJECT ACHIEVEMENTS

True strength of a few common structural timber varieties and the effect of specimen size on strength have been determined by an extensive testing procedure. In roof construction where Class I or higher class timber is commonly used, it was found that Class II timber can also be used without sacrificing strength requirements. This fact, combined with the finding that members of smaller cross sections perform equally well, amounts to about 50% savings in cost of timber.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

With rising cost of construction, it is necessary to explore ways and means of economizing the process. Considering the importance placed by the government on low cost housing, benefiting mainly people of lower middle class and poor class, the findings of this study can be directly put to use. Further, the finding that timber of class II and lower can be used more effectively, is providing a solution for diminishing structural timber resources in the country.

## **FOLLOW-UP**

It is planned to continue the research to include testing of a wide variety of structural timber for determination of strength parameters. Further, the need to develop a visual grading of structural timber is identified and will be perused as a new research area. It is expected that construction industry and the government will make use of the findings of the study, especially in low cost construction of dwelling units.

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## Electronic devices for energy saving. Design & prototype fabrication

RG/2005/E/05

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University of Moratuwa

**Co-Investigator:**

Dr. I. J. Dayawansa  
University of Moratuwa

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**Automatic Electronic Controllers** for switching ON lamps when darkness arrives (night) and for automatically switching OFF when light arrives (morning).



Installation at a Street lamp



Device

### INTRODUCTION

In Sri Lanka, the ratio of electricity growth rate to GDP growth rate is high, in comparison to energy efficient countries such as Japan. Thus, there is much room to improve demand side energy efficiency and for cost saving in Sri Lanka. Towards this the R&D undertaken was to develop (i) **Automatic Electronic Controllers** for switching-ON lamps when darkness arrives (night) and for automatically switching -OFF when light arrives (morning). (ii). **Automatic Electronic Speed and Time Controller** for a **ceiling fan**, (without the use of batteries). (iii). **An alarm to indicate unnecessary use of electricity** (without disrupting the load wires, by sensing current from outside the wires).

### PROJECT ACHIEVEMENTS

The project achieved complete success in all the aspects given in above R&D proposals. Solid state electronic circuits were designed, tested and prototypes made in the laboratory. The following papers were published: (a). Light dependent electronic controllers for switching lamps (IESL), (b). Efficient Electronic Controllers for Switching Lamps at Night. (IEE), (c). Audible Alarm to Indicate Excessive Electric Power Usage (IET). In respect of (ii) at the introduction, before this research there were no fan regulators with time control for ceiling fans. The uniqueness of the technology hinges on several factors including the fact that it acquires the electricity required for the controller from a situation where there is only the phase wire available (neutral is not available). Also, the hum and harmonics usually associated with continuously variable regulators is eliminated. The controller efficiency itself is very high as evidenced by no heating at the controller.



Installation in a domestic lamp without any new wiring



Automatic Speed and Time Controller for Ceiling fans

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

When manufacturing and use are implemented on a large scale, the devices will contribute to significant energy saving and cost saving. They will also add to the comfort of users of the product. For example, “Light dependent Electronic Controller” can be used for domestic lamps as well street lamps to switch ON automatically at dusk and switch OFF at dawn. The “Alarm to indicate unnecessary use of electricity” will first warn, by an alarm and then it can be used to trip the circuit if required.

The Automatic Electronic Speed and Time fan controller will enable switching off of ceiling fans at a pre-set time in the office and at home. Large scale production and use will save electricity cost of consumers and will also save over Rs.1 Billion per year in the long run to the country. There will be less Oxides of Carbon, Nitrogen and Sulphur emitted (through saving of fuel burning in power stations) and environment will benefit.

A major benefit to the user is cost saving through saving of energy consumed due to High efficiency. Switching off the ceiling fan automatically when exceeding the time set by the consumer. For example during sleep in the night fan may be used only for the hotter early period of the night by auto switch-off at early morning hours, even when one is sleeping.

The energy saving will depend on the usage pattern. It is estimated that for domestic use, electricity consumed for fans will be reduced by about 60%, as confirmed by trials at a number of households. Significant benefits can be realized by institutional users also.

## FOLLOW-UP

Because of fund limitation, only the item “Automatic Electronic Speed and Time controller for ceiling fans” was followed up and patented after the research was over. Further, 50 prototype samples of these controllers were tested and found to be of high performance by the Sustainable Energy Authority (SEA).

The Speed-Time controller is now being manufactured at a pre-commercial level and is available on a trial marketing basis; it is not yet available in shops but those interested can now obtain controllers through the Researcher (kkywp2004@yahoo.com) or the manufacturer (cherryelectron@sltnet.lk).

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## Genetic diversity and nest paternity of green turtle (*Chelonia mydas*) populations in Sri Lanka

SIDA/2005/BT/01

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Department of Zoology

**Co-Investigators:**

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Department of Zoology  
Dr. P. Samaraweera  
Department of Molecular  
Biology  
University of Peradeniya

### INTRODUCTION

Sea turtles are protected animals. Of the seven species of sea turtles in the world, five nest in Sri Lanka. Green turtles nesting in Kosgoda rookery in the south-western coast of Sri Lanka were studied for a five-year period from August 2003 to July 2008.



A



B

Turtle rookery at Kosgoda  
A) Nesting female green turtle  
B) A nest covered with a mesh  
to protect eggs from predators

### PROJECT ACHIEVEMENTS

Nesting behaviour, biology of nesting females and hatchlings, genetic structure and nest paternity of green turtles at Kosgoda rookery were studied. Microsatellite analysis showed a high genetic diversity within the population and presence of multiple paternities.



Nest was excavated after emergence of hatchlings to determine the hatching and emergence success of hatchlings



Skin tissues were collected from nesting females and hatchlings to determine the genetic diversity and nest paternity of the green turtles nesting at Kosgoda rookery

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Information about nesting behavior, genetic structure, prevalence of multiple paternity of green turtles is important to comprehend the population structure which is of great significance to the management and conservation of an endangered species such as green turtles. Findings of this study suggest that it is still not too late to prioritize the conservation need of the green turtle population nesting at Kosgoda rookery and highlight the importance of declaring it as a turtle sanctuary.

## FOLLOW-UP

The *in-situ* conservation program at Kosgoda initiated by Turtle Conservation Project (TCP) at the time of the study no longer exists due to financial constraints. Results of the study show that two thirds of nesting occurs within five months of the year, and therefore at least a seasonal *in-situ* programme covering the peak season can be recommended as a cost effective alternative. Surveys are being carried out to monitor the management practices and contribution towards conservation of sea turtles in hatcheries.

**For more details, contact:**

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## Expansion of rubber cultivation in the Eastern Province of Sri Lanka

RG/2005/AG/14

### Principal Investigator:

Dr. S. M. M. Iqbal

### Co-Investigators:

Dr. V. H. L. Rodrigo

Dr. R. S. Dharmakeerthi

Rubber Research Institute of  
Sri Lanka

Dartonfield

Agalawatta

### INTRODUCTION

Once a war-torn area, Eastern Province has currently been targeted for development programmes as it comprises large extent of sparsely populated land indicating the potential for establishing plantation crops like rubber. With little scope for further expansion of rubber in the traditional wet areas where rubber is presently grown, the feasibility of establishing a project on rubber cultivation in the intermediate zone of the Eastern Province was investigated.



Combining rubber with  
traditional crops

### PROJECT ACHIEVEMENTS

Despite the dry spell, the survival and growth of rubber plants in most of the sites were satisfactory and the average annual girth expansion rate was 7.00 cm. Rubber plants were harvested for latex after 7 years of planting. Photosynthetic parameters under normal circumstances were rather healthy. However, under severe drought conditions, they were affected indicating a drought-induced photo inhibition or down regulation in photosynthesis. Improved agro-management practices to alleviate the adverse effects of droughts on plant growth were identified.



Field training and social interactions



East glowing mature rubber trees

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Land availability was not a limiting factor and farmers' interest in cultivating rubber was at very high level. Extension programmes were to be strengthened to educate farmers on crop management practices of rubber. Timely distribution of planting materials, fertilizer and subsidy payments were essential components in successful establishment of rubber. Strong socio-cultural interactions have made the rural livelihood sustainable. Farmers mostly planted rubber with seasonal crops. Potential extent for planting rubber in the region was identified as 10,000 ha.

## FOLLOW-UP

Training and latex harvest assessments on mature rubber in the intermediate zone continued. Socio economic study of intercrop with mature rubber and feasibility study on establishing rubber in the dry zone of intermediate zone continued.

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## Identifying potential inhibitors for the polyamine biosynthetic enzymes in the fungi species: *Colletotrichum gleosporides*

RG/2005/AG/12

### Principal Investigator:

Prof. M. K. B. Weerasooriya  
Department of Chemistry  
University of Kelaniya



Anthracnose of avocado



Inhibition zone observed with  
*Jatropha curcus* leaf extract

**For more details, contact:**  
Prof. M. K. B. Weerasooriya  
E-mail: bandu@kln.ac.lk

### INTRODUCTION

Anthracnose which is caused by *Colletotrichum spp* is a major problem in many agricultural countries. A variety of synthetic fungicides are being used by farmers to control anthracnose disease but it leads to health risks and environmental problems. The aim was to develop environmental friendly, safe control measures to achieve sustainability.

### PROJECT ACHIEVEMENTS

Nine plant species were tested to detect their *in vitro* antifungal activity towards *Colletotrichum gleosporioides*. Ethyl acetate fractions of *Jatropha curcus*, methanolic extracts of *Acorus calamus*, *Zingiber zerumbet* and *Curcuma zedoaria* tubers. Methanolic extracts of *Lawsonia inermis* and *Allocaasia macrorrhizos* leaves and *Amorphopallus campanulatus* leaves and tubers, steam distillate of *Esantheria punctata* and *Labelia nicotaniifolia* leaves. Out of these, *Acorus calamus* extract was found to be the most effective. Extracts of *Zingiber zerumbet*, *Labelia nicotaniifolia* and *Allocaasia macrorrhizos* showed moderate activity whereas others were non effective. Further investigations under *in vivo* conditions are necessary.

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Knowledge gained through this work will be highly beneficial to small scale and large scale farmers, agricultural teaching institutes as well as Research Institutes all over the country.

### FOLLOW-UP

Further work on this project is currently underway in collaboration with Faculty of Agriculture, University of Ruhuna. Several other plant species have been tested. Some have shown more promising results. Findings will be published.

## Identification of Synergists for the Aggregation Pheromone of the Coconut Pest, *Oryctes rhinoceros* (L) to develop a low cost lure

RG/2005/AG/07

### Principal Investigator:

Prof. Neelakanthi Ekanayake  
Gunawardena  
Director  
Semiochem Lanka PVT LTD  
121  
Hunupitiya Lake Road  
Colombo-2

### INTRODUCTION

*Oryctes rhinoceros*, commonly known as the black coconut beetle, is a devastating pest on young coconut palms in Sri Lanka. An estimated 10% of yield loss due to this beetle has been reported in the region. There has been no satisfactory method to control this pest except the regular insecticide applications. Since the banning of carbofuran type insecticides, the pest problem has been escalated and the coconut industry has faced a huge problem. Black beetle populations are successfully controlled in the world using pheromone baited traps. However, the high price of this beetle's pheromone has prevented similar use in Sri Lanka. This study was undertaken with the view of finding other natural attractants which might synergize the activity of this expensive pheromone. If successful, a lesser dose of the pheromone should build the same efficiency in a lure hence cost of the lure can be kept low.

### PROJECT ACHIEVEMENTS

An efficient lure for *O. rhinoceros* consisting of its aggregation pheromone and two other attractants, 2-methoxy 4-vinylphenol and ethanol, have been formulated. These attractants were shown to enhance the activity of the pheromone in field trials (figure. 2). The dose of pheromone required for this formula is nearly 1/8<sup>th</sup> (100mg) of the standard dose (700-1000mg/lure). In field trials, this lure attracted an average of 15-32 beetles/ trap/ month, a result comparable to those using standard doses of pheromone (20-35 beetles/trap/month). The field life of the formula was 12-14 weeks compared to the 12-20 weeks of activity in similar lures available in the international market.

Since this formula works efficiently with a lesser amount of the pheromone, the cost of the lure can be reduced greatly (less than ½ the price) compared to the similar lures in the international market.



Figure-1. The adult *Oryctes rhinoceros* beetle



Figure-2. The beetle catches in a coconut estate in Pilakatumulla, Naththandiya



Figure 3. The commercial trapping system in the market

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The role of coconut industry to country's economy has become more prominent than ever since the recent revelations of nutritional and medicinal values of coconut oil. Massive projects have been launched to cover North and East with coconut palms. Since the black beetles attack on a coconut palm at its seedling/ young plant stages, the development of this lure to control this pest plays a vital role for the coconut industry.

Since the average cost of lure is almost 40% of the cost of similar lure in the market (average price US\$ 6.5) this lure is affordable to coconut growers of all socio groups.

Carbofuran type insecticides have been used to control this beetle since early days. These chemicals were banned recently. Prolonged use of insecticides effects human health. Pheromone baited trapping is completely devoid of insecticides promoting human health and cleaner environment.

The pheromone lure developed in this project is a relevant and timely product contributing to the socio economic development of Sri Lanka.

## FOLLOW-UP

A simple and economical trapping device was designed for the above lure and a complete trapping system has been put in place (figure 3).

In April 2012, a company was formed (Semiochem Lanka PVT LTD) for the commercial exploitation of this trapping system under the leadership of the Principal Investigator. This company formulates and markets the product. The trapping system is now in operation in Sri Lanka meeting the demands of the coconut growers. This product has also been an export in a limited way. The average cost of the trap has been Rs. 475 compared to US\$ 26 for a black beetle trap in the international market.

Further work is needed to improve the production process and marketability of this trapping system.

### ***For more details, contact:***

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# Influence of storage method and duration on grain quality of different rice types in Sri Lanka

RG/2005/AG/04

## Principal Investigator:

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Rice Research and  
Development Institute  
Batalagoda  
Ibbagamuwa

## Co-Investigators:

Dr. D. B. Rohitha Prasantha  
Faculty of Agriculture  
University of Peradeniya

Dr. R. F. Hafeel  
Rice Research Station  
Ambalantota



IRRI super bags used for hermetic storage

## INTRODUCTION

Rice quality is often severely affected by mold development during storage which is associated with moisture migration in the grain. Even if grain is kept sufficiently dry, insects survive and cause damage to the grain. Hermetic storage provides an excellent opportunity to control insects in stored grain, without chemical pesticides.

## PROJECT ACHIEVEMENTS

Most of the rice grain quality attributes were favourably affected during 9 months of hermetic storage. Comparatively, paddy in poly-sacks increased its moisture and led to unfavorable quality changes. Among these, reductions in mass, head grain yields, fat content and sensory qualities were significant with minute variations between varieties. Hermetic storage system is a safe and viable alternative to preserve the quality of dry paddy and to minimize weight loss.



## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Outcome of the results proved the advantage of storing paddy in hermetically sealed materials. Adopting this practice during paddy storage will help the producer and the retailer. Most of the tested grain quality parameters were better than at common storage practices. Therefore the hermetic storage system may help to obtain rice with desirable grain qualities for consumption. Due to retarded insect and microbial activities, this type of storage practice will provide favourable storage conditions with minimal storage losses.

## **FOLLOW-UP**

The Rice Research and Development Institute will disseminate the findings through workshops, seminars and presentations to the extension staff and thereby the farmers. The people who are involved in rice production will receive the research outcome. Department of Agriculture provides awareness through mass media such as radio and television programmes. Conducting experiments for the storage principle on some other food grains, and developing cost effective hermetic packing material for local use can be done to apply the findings to form more practical.

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## A study of some ecological aspects of endemic and threatened frogs, *Lankanectes corrugatus* and *Fejervarya kirtisinghei* with special reference to their tadpoles

RG/2004/ZOO/04

### Principal Investigator:

Dr. Deepthi Wickramasinghe  
Department of Zoology  
University of Colombo



*Fejervarya kirtisinghei* adult male  
(Labugama Forest Reserve)

### INTRODUCTION

This study focused on endemic and threatened frogs, *Lankanectes corrugatus* and *Fejervarya kirtisinghei*. Functional morphology, microhabitat and dietary preferences of tadpoles were examined. Population dynamics of tadpoles and adults were reported for different localities. The results have important implications for conservation in the context of present global amphibian decline.

### PROJECT ACHIEVEMENTS

This project resulted in generating important information which has been unknown yet vital in conservation of amphibians. Data gathered in this study have been used in local and international level platforms in dissemination of information: produced two abstracts and two research papers. Data have been included in IUCN International Red List Assessing for Amphibians and in the book “Threatened Amphibians of the World” (Stuart et al., ed. 2008).

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Frogs play a pivotal role in the environment, specially in the food chains and are considered as ecological indicators. Conserving them is vital to ecological balance of the environment which in turn links with economic and social settings to achieve sustainable development.

## **FOLLOW-UP**

This project has inspired new areas of research in Herpetology and we have now initiated “ecoimmunotoxicology”, studying the impacts of pollution on immunology of frogs which directly reflect their status of health.

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## Studies on the chemistry and standardization of ayurvedic medicinal oils

RG/2004/TM/03

### Principal Investigator:

Prof. A. M. Abeysekera  
Department of Chemistry  
University of Sri  
Jayawardenepura

### INTRODUCTION

‘Pinda’ oil, a potent and widely used ayurvedic medicinal oil was analyzed for the plant secondary metabolites incorporated in it. Octanol – water partition coefficients of the major constituents were determined. The rate of incorporation of selected constituents into the oil during manufacture was studied. Market samples were analyzed by HPLC.



Industrial Production of Pinda Oil



Industrial Production of Pinda Oil

### PROJECT ACHIEVEMENTS

The anthraquinones pseudo purpurin, alizarin, xantho purpurin and rubiadin, the triterpenoids  $\beta$ -sitosterol, lupeol acetate and  $\alpha$ -amyrin acetate, the flavonoids liquiritigenin and isoliquiritigenin and the phenolic scopoletin, were identified as the major secondary metabolites incorporated into ‘Pinda’ oil.

The log P values of these compounds were found to cover a wide range from 0.4 (scopoletin) to 3.5 (rubiadin)

A method for quantitative extraction of anthraquinones in the oil using solid-phase extraction (SPE) with polyamide was developed.

Based on the rate studies, a recommendation to introduce a phase separation step in the manufacturing process to increase its efficiency was made.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This study contributes towards the standardization of a widely used ayurvedic drug which is manufactured industrially. Standardization of such products is essential for the quality assurance of the health care delivery system, conducting clinical trials to further develop the ayurveda system, economic exploitation of the world-wide demand for ayurveda drugs by Sri Lanka.

Implementation of the suggestion for a change in the manufacturing process will increase the efficiency of production and lead to less consumption of fuel.

## **FOLLOW-UP**

Studies are being planned to investigate the impact of introducing a phase separation step on the quality of the product, and the effect on the overall efficiency of production at the industrial level.

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## Effects of Zinc on human semen quality and sexual behavior of male rats

RG/2004/M/14

**Principal Investigator:**

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Department of Obstetrics &  
Gynaecology  
Faculty of Medicine  
University of Kelaniya

**Co-Investigators:**

Prof. W. D. Ratnasooriya  
Department of Zoology  
University of Colombo  
Prof. S. Wimalasena  
Department of Chemistry  
University of Kelaniya

### INTRODUCTION

One in six married couples encounter unwanted delay in conception. Of the infertile couples, around 30% are solely due to male factor and male factor is contributory to another 30%. Nutritional imbalance has a significant effect on fertility. The manifestation of Zinc imbalance in different aspects of male fertility in humans and rats was studied.

### PROJECT ACHIEVEMENTS

Zinc levels in serum and seminal plasma, and fructose and neutral alpha glucosidase levels in seminal plasma were established in a Sri Lankan sub fertile male population for the first time. There were two new findings. Those are, Zinc facilitates the acrosome reaction and Zinc supplementation increases the time to ejaculate in male rats.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The research project involved assessment of male infertility using different procedures. Most of those tests are expensive, require special skills and still unavailable in Sri Lanka. Introducing new techniques with updated knowledge for a reasonable cost is beneficial in further development of this field. Facilities the laboratory were improved for this purpose. At present patients are benefitted as they can obtain advanced services within the country.

## **FOLLOW-UP**

Based on the results and knowledge obtained through the research project, a proper protocols in investigating and treating infertile males is followed. Further research projects are ongoing to address other issues emanating from this research study related to male infertility.

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# The relationship between gastro-oesophageal reflux disease (GORD) and asthma in a population of adults in Sri Lanka

RG/2004/M/07

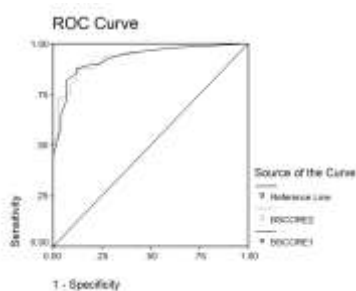
## Principal Investigator:

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Faculty of Medicine  
University of Kelaniya

## Co-Investigators:

Prof. H. J. De Silva  
Department of Medicine  
Faculty of Medicine  
University of Kelaniya

Dr. W. A. D. Lakmali Amarasiri  
Department of Physiology  
Faculty of Medicine  
University of Kelaniya



**Receiver Operating Characteristic curves for GORD symptom scores 1 and 2**  
Cut-off scores of  $\geq 11.5$  for GORD score 1 and  $\geq 12.5$  for GORD score 2, gave correct classification of symptomatic GORD with sensitivities and specificities over 90%.

## INTRODUCTION

Gastro-oesophageal Reflux Disease and asthma are linked through several mechanisms, all thought to be vagally mediated. This study describes the relationship between GORD and asthma by investigating the prevalence of GORD symptoms, upper gastrointestinal motility abnormalities and possible mechanisms in a cohort of mild stable adult asthmatics in Sri Lanka.

## PROJECT ACHIEVEMENTS

The first ever report of the prevalence of GORD symptoms and oesophageal motility abnormalities in adult Sri Lankan asthmatics; a valid interviewer administered GORD-specific questionnaire in Sri Lanka; gastric myoelectrical activity and gastric emptying (GE) in asthmatics; GE of solid meals in Sri Lankan adults and the vagal response to intra-oesophageal acid infusion.

It also strengthens the hypothesis that GOR triggers asthma through a vagally mediated oesophago-bronchial reflex.





Assessment of the lower oesophageal sphincter (LOS) during oesophageal manometry

Note peristaltic waves in top 3 channels and relaxation of the LOS in the lowermost 4<sup>th</sup> channel.



Gastric emptying real-time ultrasound scan showing the plane used to obtain the cross-sectional antral areas.

The positioning allows simultaneous visualization of the antrum, superior mesenteric artery and abdominal aorta.

L = liver

PA = pyloric antrum

SMA = superior mesenteric artery

AO = aorta

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This study emphasizes the importance of considering GORD as a cause of refractory asthma and in context of the high usage of oral drugs for asthma, the contribution of asthma severity and medication towards GORD. Treatment of one condition benefits the other and reduces the need and cost of medication. The GORD screening questionnaire can be used in epidemiological studies as well as in clinical practise to screen for GORD.

## FOLLOW-UP

Several studies on other extra-oesophageal manifestations of GORD have been carried out are being planned, namely: The prevalence of upper respiratory symptoms in GORD patients, The prevalence of GORD symptoms in patients with Chronic Obstructive Pulmonary Disease and The prevalence and patterns of primary headache disorders and effect on quality of life in a population of adults with symptomatic gastro-oesophageal reflux disease (GORD) and its association with autonomic function.

## 3D Reconstruction and shape analysis of electrical discharges through image processing

RG/2004/E/06

**Principal Investigator:**  
Prof. D. U. J. Sonnadara  
Department of Physics  
University of Colombo



Image of a spark channel and reconstructed trajectory

### INTRODUCTION

Natural as well as artificial electrical discharges show a luminous, complex discharge patterns during their progression. Long electrical discharges and surface discharges take a stepwise tortuous path when delivering the charge accumulated in one electrode to another. The discharge paths, different from one to the other, is probably determined by a variety of parameters related to electric field directivity, distribution of space charges, environment conditions etc.

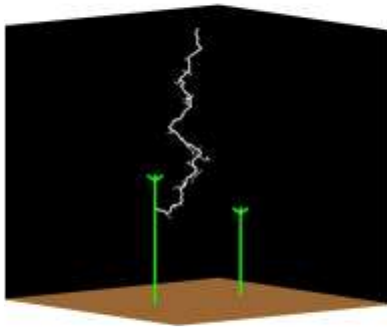
The main objective of this research work was to study the path of propagation of discharge channels and to develop a simulation program for 2D and 3D propagation of electrical discharges.

### PROJECT ACHIEVEMENTS

Using a set of photographic images, physical properties and characteristics of long laboratory sparks were studied based on image processing techniques. Models were developed to simulate electrical discharges in 2D and 3D and compared with the available experimental results.



Simulated 2D radial discharge pattern



Simulated lightning discharge influences by two ground objects with different heights

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Prof. D.U.J. Sonnadara

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The following contributions are made through this project towards scientific advancement: Estimation of channel tortuosity of 500 mm long laboratory sparks; Development of a method to estimate branch currents in complex electrical discharges through the measurement of optical intensities; Estimation of channel complexity of electrical discharges through fractal techniques; Extending the standard dielectric breakdown model (DBM) to simulate electrical discharges for variety of configurations in 2D and 3D.

The results of this project are useful for our understanding of the effect of tortuosity on the generation of EM fields due to natural lightning and the development of electrical treeing on insulators which can eventually lead to the electrical breakdown of insulators.

## FOLLOW-UP

With the continuation of the work, 3D model will be extended to simulate and rendering of lightning discharges.

A strong link was established with the High Voltage Laboratory of the Uppsala University, Sweden to pursue further studies in this area. Additional experimental measurements are already underway to collect more data to expand this work.

With the knowledge gained, several projects in the area of computer vision were initiated to study real life problems and promising results have already been obtained.



## Insecticidal compounds from *Gnidia glauca* to develop bio-friendly insecticides

RG/2004/C/01

### Principal Investigator:

Dr. Vijay Kumar  
Department of Chemistry  
University of Peradeniya

### Co-Investigator:

Dr. Anoma P. Mudalige  
Department of Chemistry  
Open University of Sri Lanka



*Gnidia glauca* tree



*Gnidia glauca* leaves and flower

### For more details, contact:

Dr Vijay Kumar  
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### INTRODUCTION

The fresh leaves and twigs of *Gnidia glauca*, a small tree found in the Central Province is used by farmers in Sri Lanka to control pests in paddy cultivation. The work aimed at identifying the active compound so that they could be developed into environmentally friendly crop protection agents.

### PROJECT ACHIEVEMENTS

Only fresh plant samples of *Gnidia glauca* showed laticidal activity, not dried samples and the stem. Bark showed more activity than leaves. Extracts and active fractions lost their activity in about three months. This could be due to thermolability or decomposition of the active compounds or activity being due to synergism, although no evidence of the latter was seen. Two compounds, a weakly active bicoumarin, and an inactive diterpene, were isolated.

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The importance of the farmer technique of using fresh plant material when using *Gnidia glauca* for plant protection was shown.

### FOLLOW-UP

It may be worth studying water extracts of *Gnidia glauca* to determine whether they contain any insecticidal compounds.



## Isolation of a gene encoding a nematode-specific fatty acid and retinol-binding protein (*far-1*) from the filarial parasite *Setaria digitata*

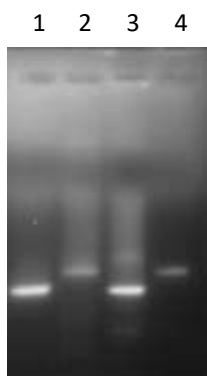
SIDA/2004/BT/03

### Principal Investigator:

Dr. Sharmila Jayasena

### Co-Investigator:

Dr. Sulochana Wijesundera  
Department of Biochemistry  
and Molecular Biology  
Faculty of Medicine  
University of Colombo



PCR products of *far-1* gene from *Setaria* cDNA and *B. malayi* genomic DNA. Lane;

- 1 *S. digitata* cDNA with primers F2 and R2
- 2 *S. digitata* cDNA with primers F2 and R1
- 3 *B. malayi* genomic DNA with primers F2 and R2 (650 bp)
- 4 *B. malayi* genomic DNA with primers F2 and R1 (700 bp)

### For more details, contact:

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### INTRODUCTION

Parasitic nematodes secrete a structurally novel type of fatty acid and retinol binding protein (FAR). This project aimed to isolate and sequence-characterize the *far-1* gene from the cattle filarial parasite, *Setaria digitata*.

### PROJECT ACHIEVEMENTS

This project revealed the existence of the endosymbiotic relationship between *Setaria* species and the endosymbiont *Wolbachia*. The *Setaria digitata far-1* gene appears to be interrupted by lateral gene transfer of *Wolbachia* Na<sup>+</sup>/H<sup>+</sup> antiporter gene sequences. The isolated fragment also contained what appeared to be intronic sequences. The phenomenon of lateral gene transfer, although described for nematodes, has not been identified in *Setaria* before.

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This project contributed to capacity building in molecular biology. Several students were trained in research techniques and contributed to completion of degrees.

### FOLLOW-UP

This project revealed unexpected and interesting results which require further clarification and investigation. The fragment amplified by RT-PCR may represent a pseudogene which is being transcribed or contaminating genomic DNA fragment.

# Study of the frequency of genetic thrombophilic polymorphisms in the Sri Lankan population and the association of these polymorphisms with pre-eclampsia, and the study of the association of genetic thrombophilic polymorphisms with recurrent pregnancy loss

SIDA/2004/BT/01 and SIDA/2005/BT/04

**Principal Investigator:**

Prof. Vajira H. W. Dissanayake  
Human Genetics Unit

**Co-Investigators:**

Prof. Rohan W. Jayasekara  
Gayani Gammulla  
Sumali Jayaweera  
Dr. Nirmala Sirisena  
Human Genetics Unit

Prof. Harsha R. Senevirathne  
Department of Obstetrics and  
Gynaecology

Faculty of Medicine  
University of Colombo

## INTRODUCTION

Thromboembolic diseases which include ischaemic stroke, ischaemic heart disease, pulmonary embolism, various types of venous embolism, and deep vein thrombosis, to name a few major conditions place a heavy burden on health care services and account for significant morbidity and mortality. In addition pregnancy related conditions such as pre-eclampsia and recurrent pregnancy loss which have an underlying Thrombophilia aetiology cause significant morbidity and mortality among otherwise normal pregnant women. Genetic mutations cause familial thrombophilias. The objectives of these two studies were to establish the prevalence of the three well known Thrombophilic mutations – Factor 5 1691G>A (Leiden), Factor 2 (Prothombin) 20210G>A, and MTHFR (Methylene Tetrahydrofolatereductas) 677C>T - in Sinhalese, Tamils and Moors in the Sri Lankan population and to examine the association of these mutations with pre-eclampsia and recurrent pregnancy loss in Sinhalese women.

## PROJECT ACHIEVEMENTS

The project resulted in the establishment of the prevalence of these mutations in the Sri Lankan population.

The project also resulted in the finding that these mutations were not associated with pre-eclampsia and recurrent pregnancy loss among Sinhalese women.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

These research projects resulted in the introduction of genetic testing for Factor 5 1691G>A, Factor 2 2010G>A and MTHFR 677C>T mutations to Sri Lanka. Since January 2006 we have been offering testing for these mutations as a clinical genetic diagnostic service. More than 1000 patients have been tested in our labs so far for these mutations.

The medical community in the country has benefited from the availability of the tests in the country and the patients have benefited from genetic testing, appropriate treatment, genetic counseling and follow up.

The availability of these tests in Sri Lanka has saved large amount of foreign exchange to the country, which would otherwise have gone out of the country, to send samples for genetic testing abroad as well as to pay for the tests. It has also resulted in the creation of jobs for scientists in our genetic diagnostic laboratories to handle the workload associated with performing genetic testing for thrombophilias.

## **FOLLOW-UP**

With the establishment of the first Next Generation Sequencing company in Sri Lanka, Credence Genomics, which was associated with the Global Forum of Sri Lankan Scientists organized by the Government of Sri Lanka, it is planned to introduce a more comprehensive genetic thrombophilia screening panel to Sri Lanka.

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# Evaluation of biomarkers in food fish Tilapia as potential tools in biological monitoring of aquatic pollution in Sri Lanka

RG/2003/ZOO/05

**Principal Investigator:**  
Prof. Asoka Pathiratne  
Department of Zoology  
University of Kelaniya

## INTRODUCTION

This study evaluated selected biochemical biomarkers in Nile tilapia (*Oreochromis niloticus*), a food fish widely distributed in inland water bodies as potential tools in biological monitoring of aquatic pollution in Sri Lanka. The selected biomarkers were evaluated in the fish maintained under laboratory conditions and in the fish from selected water bodies using standard techniques with optimized assay conditions developed for this fish species.

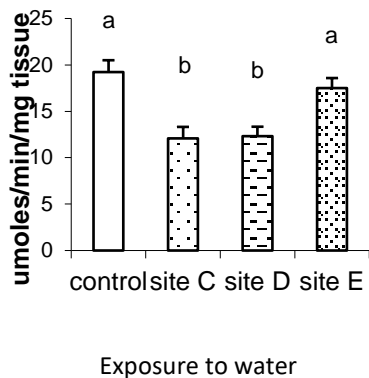


Nile tilapia(*Oreochromis niloticus*)

## PROJECT ACHIEVEMENTS

This study generated new knowledge on biomarker response patterns viz. Cholinesterase (ChE), Ethoxyresorufin O-deethylase (EROD), Glutathione-S-transferase (GST) and Metallothioneins (MT) of Nile tilapia, the fish widely used in aquaculture and fisheries in Asian countries.





Depression of Brain AChE activities of Nile tilapia exposed to water collected from canals near paddy fields after application of insecticides, fenthion and phenthoate (site C&D) indicating insecticide exposure (site E: main canal joining the Kelani river) Data are presented as means  $\pm$ SEM, n =13-20, Bars indicated with different letters are significantly different from each other

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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Pollution of aquatic environments in Sri Lanka from various sources poses a significant hazard not only to aquatic life but also to human health as well. The results of this research study provided strong evidence that a suite of pollution indicative biochemical biomarkers in Tilapia are economical and promising tools for biomonitoring of pollution status in inland water bodies. Hence these biomarkers can be used in future biomonitoring programmes and environmental impact assessment activities in the country.

## FOLLOW-UP

This was the first study which attempted to assess the pollution of aquatic environments in Sri Lanka using the biomarker strategy. Based on the findings of the project, in the next phase of study, biomarker responses in feral fish were applied in two selected waterbodies viz. Bolgoda North Lake and Bathalagoda reservoir in Sri Lanka to evaluate temporal trends and spatial variation in aquatic pollution in the two water bodies.



## Effect of feeding different dietary levels of coconut oil on the conjugated linoleic acid in goat milk

RG/2003/V/04

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Experimental study at the  
Imbulandanda Goat Breeding  
Centre

### INTRODUCTION

Conjugated linoleic acid (CLA) is a mixture of positional and geometrical isomers of linoleic acid which is found mainly in dairy products. CLAs are recognized as having anti-carcinogenic, antioxidant, antiarteriosclerosis properties. The study was conducted to find the effect of coconut oil in ruminant diet on the CLA content of goat milk.

### PROJECT ACHIEVEMENTS

The level of coconut oil in the diet of goats had a significant influence on CLA content of the milk fat. Goat fed with 2.5% of coconut oil had the highest level of CLA in their milks, compared with goats fed with 0% coconut oil. High levels of (5%) coconut oil reduced the CLA in milk. There was no treatment effect on the crude protein levels of the milk.

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Coconut poonac is one of the major concentrates given to cattle in Sri Lanka. Total fat content of coconut poonac varies from 7-12 % according to the type of processing. This study showed that the goats fed with 2.5% of coconut oil had the highest level of CLA. Therefore to get high content of CLA in milk, the amount of coconut poonac given to an individual has to be manipulated.

## **FOLLOW-UP**

Facilities obtained from the grant were used to explore linoleic acid rich plant materials available in Sri Lanka to feed lactating ruminant animals to improve their milk CLA content.

A study was conducted to examine the effect on CLA concentration of milk by the dietary supplementation of a selected LA rich plant material.

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## Development of Lipopolysaccharide core vaccine to control *Escherichia coli* infections in chickens

RG/2003/V/01

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Department of Veterinary

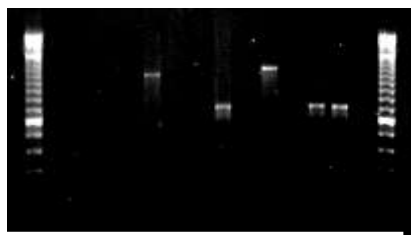
Microbiology

Faculty of Veterinary

Medicine and Animal

Science

University of Peradeniya



1 2 3 4 5 6 7 8 9 10 11 12 13

Figure 1: PCR amplified products of R2 (lane 5 &10) and R4 (lane 8, 12,13) LPS core types

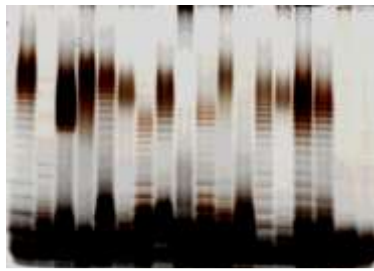
### INTRODUCTION

Infections caused by *Escherichia coli* (*E. coli*) make an economically significant impact in the poultry industry and non-serotype specific vaccine appears to be the most logical method of controlling it. The core oligosaccharide region of bacterial lipopolysaccharide is well conserved and highly immunogenic. This study focused on developing a broadly cross protective lipopolysaccharide core vaccine to control *E. coli* infections in chickens.

### PROJECT ACHIEVEMENTS:

Five distinct lipopolysaccharide (LPS) core types namely R1-R4 and K12 have been identified in *E. coli* and the distribution of those oligosaccharide core types among avian pathogenic *E. coli* is important to determine the LPS core types to be incorporated in the vaccine. 196 avian *E. coli* isolates were screened by PCR to identify LPS core types commonly associated with avian pathogenic (APEC) *E. coli* (Figure 1). Results indicated the *E. coli* with R1, R2, R3 and R4 were important in causing infections in chickens.

Lipopolysaccharide was extracted from 64 *E. coli* strains using aqueous phenol method. Of those, four rough *E. coli* strains possessing R1, R2, R3 and R4 core types were identified by polyacrylamide gel electrophoresis (Figure 2). Lipopolysaccharide of R1, R2, R3 and R4 core types were then incorporated into liposome consisted egg phosphatidylcholine and bovine brain phosphatidylserine and cholesterol to reduce toxicity. Endotoxicity of liposome incorporated and free LPS were measured by the Limulus amoebocyte lysate assay. Liposome incorporated LPS were at least 1000 times less toxic than free LPS.



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Figure 2: Heterogeneity of smooth and rough LPS of *E. coli*. Lane 10,12,14,16 contain rough LPS selected for the vaccine. Other strains show smooth LPS patterns

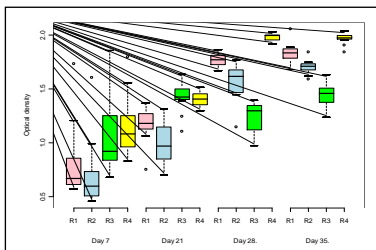


Figure 3: Serum antibody responses of chickens immunised with two doses of 5 µg of liposome

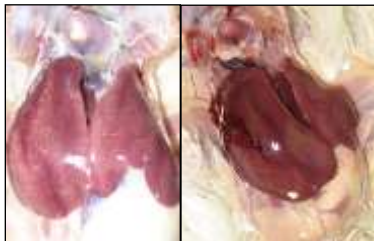


Figure 4: Post mortem findings of chickens used in the vaccination study

- a. Perihepatitis and pericarditis in un-immunized Chicken
- b. Immunized bird with no lesions in the liver or heart

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When tested on chicken macrophages cell line (HD11) liposome incorporated LPS produces significantly less cytokines. Chicks when immunized with 0.2µg, 1 µg and 5 µg of liposome encapsulated mixture of complete core type vaccine showed that the antigenic response increased with increasing dose. The birds received 5µg of liposome encapsulated LPS had significantly high ( $p<0.001$ ) anti-LPS core antibody titres (Figure 3) than the chicks in all other groups and also protected the birds against lethal challenge with *E. coli* O78 µg. The liposome encapsulated, mixture of complete LPS core vaccine was non-toxic and showed greater potential to protect chickens against heterologous challenge.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

*Escherichia coli* (*E. coli*) causes various extra intestinal infections, collectively called as colibacillosis in chickens. These infections cause severe economic losses to poultry farmers through high mortality, growth depression, cost of antimicrobial therapy and carcass downgrading. The emergence of antimicrobial resistant strains has limited the use of antimicrobial agents in controlling the infection. Development and use of broadly cross protective LPS core vaccine will help the advancement of poultry industry by controlling *E. coli* infections in Sri Lanka. In addition use of vaccine will help to reduce antimicrobial usage in poultry industry and consequently the potential public health risks entailed by the antimicrobial residual in poultry products.

We identified the LPS core types and some virulence genes associated with avian pathogenic *E. coli*. This knowledge can be used in diagnosing colibacillosis in chickens.

## FOLLOW-UP

The avian *E. coli* isolates used in the study were screened for 16 virulence associated genes and analyzed by Multi Locus Sequence Typing (MLST) to differentiate avian pathogenic *E. coli* from commensal causing opportunistic infections. This knowledge can be used to further improve the vaccine.

# Structure and diversity of montane rain forest plant communities at Dothalugala in the Knuckles Mountain Range, Sri Lanka

RG/2003/FR/02

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Dothalugala Man and Biosphere Reserve is located within the southern and south eastern parts of the Knuckles conservation region, (7° 17'– 7° 21' N and 80° 49'– 80° 57' E) in Sri Lanka and endows a high scenic beauty.

## INTRODUCTION

High geographical and climatic heterogeneity in the Dothalugala Man and Biosphere Reserve bestows different montane forest communities with a high and majestic floristic richness, though the area had received poor scientific attention. Furthermore, it is a major water catchment of the River Mahaweli. Unfortunately, the area has been disturbed due to various anthropogenic activities and some parts need to be rehabilitated for the conservation of its rich biodiversity.

## PROJECT ACHIEVEMENTS

Three different natural forest communities in the Dothalugala Man and Biosphere Reserve have been revealed by this study, namely, Upper montane forest, Mid-elevational dry-face forest and Mid-elevational wet-face forest communities. Spatial heterogeneity of the vegetation (forest structure, plant diversity and species composition in these plant communities) is an artifact of abiotic features such as the elevation, climate and the edaphic features. Hundred and fifty four plant species belonging to 57 plant families were found and many of these are endemic to Sri Lanka. Twenty seven globally threatened and 12 nationally threatened plant species were among these. Cardamom cultivation has proven to be creating severe adverse impacts on the endemic and threatened flora.



This study revealed a perfect out-door laboratory with the potential to be used in ecological education.



Many rare and threatened plant species inhabit the area. Magnificent *Kendrickia walkeri* (a climber) on canopy tops in upper montane forest communities is one such

## RELEVANCE TO SOCIO-ECONOMIC DEVELOPMENT OF THE COUNTRY

The knowledge gained would undoubtedly be useful in conservation of plants and the whole ecosystem of the area and restoration of degraded areas in the Knuckles massif.

Further, it provides ecological information and hence may create a positive impact on the ecotourism industry and environmental education of the country.

## FOLLOW-UP

Soil seed bank of the three forest communities identified are currently being studied with a view to finding ways to restore the degraded and abandoned cardamom cultivation sites in the area.

With the knowledge gained through this project, an ecotour guide for the Dothalugala Man and Biosphere Reserve was prepared.

Undergraduates of the University of Peradeniya are taken to this site every year to teach advanced ecology and restoration of tropical montane forests.

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# A comparative study on the biodiversity of selected isolated hills in the lowland penneplain of Sri Lanka

RG/2003/BM/01

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## INTRODUCTION

This study documented the diversity, ecology and biogeographical affinities of selected groups of plants and animals in three of the lesser-studied isolated hills of Sri Lanka viz. Monaragala and Kokagala in the Eastern intermediate zone and Doluwakanda in the northern intermediate zone.

## PROJECT ACHIEVEMENTS

These three hills collectively harbour 17% of the total angiosperm flora, 11% of ferns and 15% of endemic species of the island including a number of rare and threatened species as well as species new to science.

Several unique forest communities dominated by rare endemic tree species have also been identified. Biogeographically, 33% of the plant species recorded is wet zone elements.

These biologically rich isolated hills need protection as a priority.



## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

These isolated hill forests provide all important ecosystem services including fresh water supply, medicinal plants, firewood, aesthetic, educational and recreational services for the well-being of the stakeholder communities.

These relict forests are also a repository of genetic diversity of plant species of potential economic importance replete with traditional knowledge of their utility value and sustainable lifestyles.

Hence, these landscapes are living examples of the Man and The Biosphere Concept in practice.

## **FOLLOW-UP**

These three hills harboring one sixth of the angiosperm floristic richness of the entire island are eminently suitable to be included in the national protected area system.

This has been recommended to the relevant authorities particularly in view of our national obligations in meeting the Aichi Biodiversity Targets listed in the Biodiversity Strategic Plan for 2011-2020 of the Convention on Biological Diversity.

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