



# HIGHLIGHTS OF COMPLETED RESEARCH GRANTS (2017-2022)

June 2023



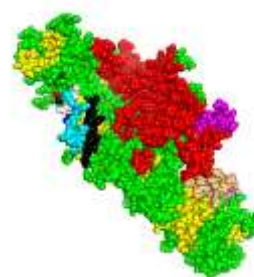
Research Division | National Science Foundation

## Highlights of Completed Grants 2017

- 01. Grant No** : **RG/2014/BT/03**
- Investigators** : **Dr CharithaLakshiniGoonasekara**  
**Dr Prasad Premaratne**  
**Prof. Roshan Perera**  
Director, KDU-CARE  
General Sir John KotelawalaDefence University  
Kandawala Estate, Rathmalana
- Project Title** : **Development of a vaccine candidate with a broadly reactive neutralizing immune response against dengue**

This study proposed an alternative strategy to the commonly used tetravalent-type vaccine design strategy to focus on conserved epitopes and therefore, aimed to identify a conserved DENV protein epitope that elicit broadly cross-reactive and neutralizing antibodies during natural dengue infections.

The findings of this study have practical applications. The identified broadly immunogenic neutralizing epitopes appear as promising candidates for an epitope based vaccine. The characterization of this vaccine candidate with animal testing, clinical trials and GMP standards will lead to establish a novel vaccine for dengue. This will contribute to uplift the pharmaceutical capacity of the country. At the same time serotype specific peptides identified during this study could be applied as an ELISA based diagnostic marker for identifying the dengue serotype of infection that can be used as a user-friendly low cost method in diagnostic laboratories.



*Figure: The locations of the broadly immunogenic neutralizing E protein epitopes on DENV E protein (PDB 3J2P)*

- 02. Grant No** : **RG/2012/BT/02**
- Investigators** : **Prof. W. S.S. Wijesundara**  
Dr N. V. Chandrasekharan  
Prof. R. L. C. Wijesundera  
University of Colombo
- Project Title** : **Cloning and expression of cellulase and xylanase genes of *Trichoderma* in a yeast system to develop synergistic saccharification and direct fermentation of cellulosic biomass to ethanol**

Ethanol production using cellulose and hemicelluloses such as endoxylanases, the major component of plant biomass has been selected as a key area for R& D in many countries. This study was carried out with the objective to express the cellulose and xylanase genes in yeast to develop a recombinant yeast system, harbouring cellulose and xylanase genes, capable of direct ethanol production from lignocellulosic biomass.

The findings of the project can lead to both industrial scale ethanol production and cellulose and xylanase enzyme production. This can be applied in various other industries such as textile, brewery, food and feed and agriculture.

**03. Grant No : RG/2014/BT/01**

**Investigators : Dr Dharshani Bandupriya  
Dr Vijitha Vidhanaarachchi  
Tissue Culture Division**

**Dr S. A. C. N. Perera  
Genetics & Plant Breeding Division  
Coconut Research Institute**

**Project Title : Studies on cryopreservation of embryogenic callus from unfertilized ovaries using the encapsulation – dehydration technique and post thaw plant regeneration in coconut (*Cocos nucifera* L.)**

Coconut seed does not have a dormancy period thus limiting the conventional storage. This study was carried out with the objective to develop a reliable cryopreservation technique, which is the only viable option available for the long-term conservation of germplasm for coconut using unfertilized ovary derived embryogenic callus.

The findings of the present study showed the feasibility of using coconut embryogenic calli for the purpose of cryopreservation. This is the first report on using coconut embryogenic calli for the long-term storage of coconut germplasm. The research findings will support developing a new *in-vitro* conservation method for coconut and this will enable conserving precious germplasm for future use.

**04. Grant No : RG/2011/BT/08**

**Investigators : Dr C. D. Wijayarathna  
Dr N. V. Chandrasekharan  
Faculty of Science  
University of Colombo**

**Project Title : Molecular characterization of bacteria involved in bioremediation of heavy metals and elucidation of possible bioremediation mechanism**

Toxic effect of heavy metal contamination has become a major threat to public health and environment. Bioremediation is the process of using microorganisms to remove pollutants. This research was conducted with the aim of characterizing bacterial strains involved in bioremediation from effluent samples collected from textile dyeing industry and study of possible mechanism of metal tolerance.

The findings of this research will help to find the mechanism behind the metal tolerance of bacterial strains. The data obtained in this study will benefit further studies in metal resistance genes which have not studied in detail. The identified bacterial strains showed significant metal tolerance and resistance to metal ions and also have shown metal uptake from the medium with time. As such, this can be used as a potential tool for heavy metal bioremediation after studying pathogenicity and other virulence factors.

**05. Grant No** : **RG/2011/AG/07**  
**Investigators** : **Dr Ilmi Hewajulige**  
Industrial Technology Institute  
**Dr Jaanaki Gooneratne,**  
Industrial Technology Institute (till June 2013)

**Prof. Jennifer Perera,** University of Colombo

**Ms D. M. W. D.Divisekara**  
**Ms A. B. C. G. J. De Silva**  
**Ms T. M. D. A. Jayawardena**  
Industrial Technology Institute

**Project Title** : **Formulation of therapeutic probiotic foods as an alternative treatment for *Helicobacter pylori* infection conditions**

More than 50% of the world's population is infected with *Helicobacter pylori*, the main causative organism for gastric and peptic ulcers, gastric cancers or mucosa associated lymphoid tissue (MALT) lymphoma. Currently, this infection is treated with antibiotics along with proton pump inhibitors which lead to several side effects. This research was conducted to isolate and characterize probiotic bacteria with anti*Helicobacter pylori* activity, from selected food sources to develop a functionally active food (beverage) that can be used as an alternative treatment of *H. pylori* induced gastric ulcers.

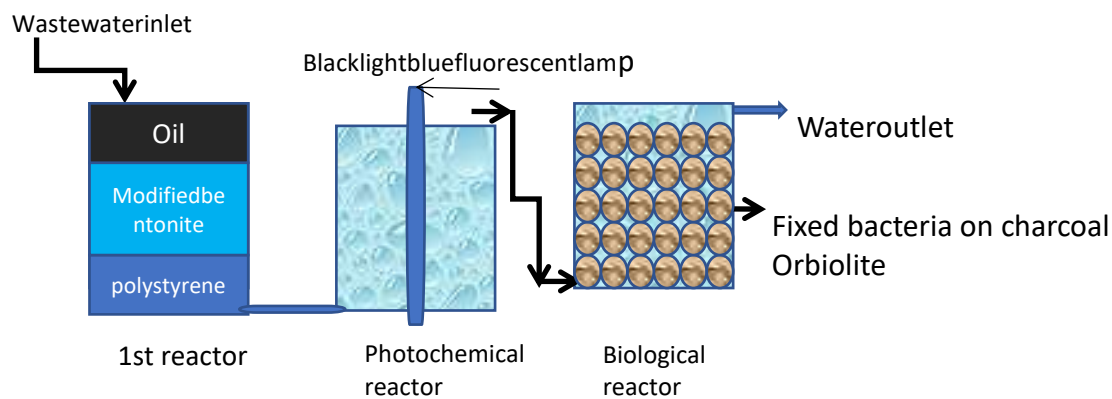
Rice varieties such as *Suwadhel*, *Madathawal*, *Sudukekulu*, *Rathukekulu*, *Basmathi*, barley and coconut milk were used as the source to isolate probiotic bacteria. *Pediococcus pentosaceus* which is isolated from *Madathawal* rice was the most potential probiotic candidate with anti *H. pylori* activity based on joint FAO/WHO Working Group Guidelines. This is an initiation to develop therapeutic food using locally isolated strains and local raw material.

**06. Grant No** : **RG/2012/ESA/01**  
**Investigators** : **Prof. Jayasundera Bandara**  
National Institute of Fundamental Studies

**Project Title** : **Design of Biological and Advanced Oxidation Technology (AOT) hybrid reactor system for oil wastewater treatment**

Automobile service station wastewater has been a heavy environment pollutant and a major topic of environment science fields. The service station wastewater pollutes surface water sources as well as ground water sources. Water treatment and purification was accomplished through a variety of chemical and physical separation techniques. However, it is well known that in Sri Lanka, most of the industries and especially service stations do not have proper waste water treatment plants owing to high operational cost. Hence, considering the environmental impact, introduction of on-site, cheap water treatment plant for the small-scale industries is very timely.

As the outputs of this study, laboratory scale affordable reactor that has preliminary physical adsorption reactor, a chemical reactor and a biological reactor was developed for the purification of oily waste water from service stations. The filters that have been developed are cheap and easy to handle, while it could effectively separate water from the different oil-water mixtures. The findings of this research have impacts on socio-economic development of the country, as treatment of oily waste-water makes it possible to recycle the water, reducing the cost of water requirement in the industry. The research findings also improve well-being of the people through controlling water pollution which threaten the biodiversity and healthy living.



**Figure:** Schematic diagram of a full running coupled reactor

**07. Grant No** : **RG/2011/HS/14**  
**Investigators** : **Prof. Pujitha Wickramasinghe**  
**Dr Tharanga Thoradeniya**  
**Dr Carukshi Arambepola**

University of Colombo

**Project Title** : **Vitamin A and iron status among pregnant mothers and their offspring in an urban area of Sri Lanka**

Anaemia is the most common nutritional problem in pregnant mothers. Iron deficiency is a major cause of anaemia during pregnancy and recent evidence suggests that it can be a cause for poor cognitive performance and development in infants. This study was conducted to assess and compare the status of anaemia, iron and vitamin A in women before and after micronutrient supplementation during pregnancy, as per the national maternal health programme of Sri Lanka and to assess the effect of postpartum vitamin A mega dose supplementation among pregnant mothers and their offspring.

The results indicate that more than 50% of pregnant mothers begin their pregnancy with iron deficiency and are undiagnosed in antenatal screening. The findings of this study help to evaluate the current national maternal health programme and modification of the micronutrient supplementation in pregnant women. The Ministry of Health has also agreed in principal to use serum ferritin instead of haemoglobin in national screening programmes for anaemia based on the study results. The research outcomes will help improve the health of pregnant women and their offspring which will ultimately improve the health and well-being of the society.

## Highlights of Completed NTRP Food Security Grants

**Grant No** : **NTRP/2012/FS/PG-01/P-01**

**Project Leader (PL)** : **Dr R.M. Herath**  
Department of Agriculture, Peradeniya

**Project Title** : **Development of a web based crop forecasting system in Sri Lanka**

The objective of this study was to develop a web based system to provide timely and reliable information on crop yields, area planted and production, through the collection of agronomic and other farm information at farm level.

The web-based crop forecasting system developed by PL and his team from the Department of Agriculture with technical expertise from the University of Colombo School of Computing, has been accepted by the Ministry of Agriculture and the system is being used by the Ministry (after making some minor modifications) for monitoring food production island wide and to implement the fertilizer subsidy scheme and a farmer insurance scheme. The programme was deployed by HE the President.

This system collects information on cultivation of different crops by farmers and is fed into the system by the Agriculture Research and Production Assistant (ARPA), which is being updated twice a month. The system stores the data and generate analytical tables which contain useful information such as extent cultivated, expected production, marketable surplus, and losses due to floods, drought or pest damage. The information is accessible at Agrarian Service Centres, and at District and National level, for decision making for ensuring food security, planning and monitoring the fertilizer subsidy scheme and the farmer insurance scheme.



**Grant No** : **NTRP/2012/FS/PG-01/P-02**

**Project Leader (PL)** : **Prof. GihanWikramanayake**  
University of Colombo School of Computing, University of Colombo

**Project Title** : **A social Life Network to enable farmers to meet the varying food demands of the population, by providing needed information just in time (real time basis) and better monitoring and management of crop production**

Farmers require information at all stages of the farming life cycle in order to make optimal decisions. The required information includes not only prior knowledge in crop production but also real time information on market prices and current production levels of a given crop.

The deployed version of the Mobile Agriculture Information System can register a farm and a farmer, select crops and varieties suitable for the location, estimate the cost of production based on information on fertilizer and pesticide requirements and their present market price, view prices being offered to the particular crop on real time basis in and around the site of cultivation, and even get advice from relevant authorities in case of a pest or a disease outbreak.



**Grant No** : **NTRP/2012/FS/PG-05/P-02**

**Project Leader (PL)** : **Prof. G. Mikunthan**  
Faculty of Agriculture, University of Jaffna

**Project Title** : **Development of a sustainable integrated food production systems to enhance household food and nutritional security, economic growth and livelihood of resource poor families in the Northern Region of Sri Lanka**

The project was aimed at developing a sustainable and integrated food production system in the households to enhance household food and nutritional security, economic growth and livelihoods of resource poor families in the Northern region of Sri Lanka. After the war ended in 2009, the war affected families were resettled in various places in Northern Province.

A survey was conducted to assess the livelihood of the people especially on the resources available, both in terms of manpower as well as infrastructure, income generation, their diets and living standards. Based on the survey one home garden was selected in each district and keeping them as a model, training programs were conducted periodically to educate them to understand the role of home gardens, their composition and provision of food and other services to uplift their livelihoods.

Accordingly, model home gardens were developed by the household members. Training and essential inputs were provided by the project in five districts (Jaffna, Kilinochchi, Vavuniya, Mullaitivu and Mannar). Meantime, a model garden was established at the Faculty of Agriculture at Ariviyal Nagar, Kilinochchi to demonstrate the importance of the different components of the home garden and its diversity. The home gardens established in different districts as well as the changes that have taken place in the livelihood of the people were assessed regularly.

Over the project period the livelihood of the resettled people improved tremendously. The home gardens provided fresh fruit and vegetables for home consumption. In some cases excess was sold or exchanged with neighbours.

## Highlights of Completed Grants 2018

- 01. Grant No** : **RG/2014/BT/02**  
**Investigators** : **Dr G. H. C. M. Hettiarachchi**  
**Dr N. V. Chandrasekharan**  
University of Colombo
- Project Title** : **Screening, isolation and characterization of type II restriction enzymes from bacteria isolated from different regions of Sri Lanka**

This study proposed isolation and characterization of restriction enzymes from bacteria isolated from different regions and habitats of Sri Lanka.

Screening of bacteria led to isolation of 09 restriction enzyme producing bacterial strains. Based on the isolation and characterization, two restriction enzymes were selected as suitable for further analysis. The putative genes for these restriction enzymes were identified. Further analysis on the large scale production of recombinant enzymes has to be explored and characterization of restriction enzymes from other bacterial isolates to be done with the view of commercialization. The findings of this study have practical applications.

- 02. Grant No** : **RG/2015/BT/04**  
**Investigators** : **Dr Renuka Attanayake**, University of Kelaniya  
**Mr K. P. Somachandra**  
Regional Agricultural Research & Development Centre  
Bandarawela
- Dr C. S. K. Rajapakse**, University of Kelaniya
- Project Title** : **Genetic diversity and management of cabbage white mold pathogen, *Sclerotinia sclerotorum*, and feasibility of Anaerobic Soil Disinfestations (ASD) and Bio-Fumigation (BF) based disease management for upcountry vegetable production system**

This project focused on determination of population genetic diversity and feasibility of Anaerobic Soil Disinfestation (ASD) in disease management in Sri Lanka. High genetic diversity was detected and ASD was effective in managing the pathogen survival structures.

The project generated new knowledge on pathogen genetics, behavior and introduced potential ecofriendly management strategies for the first time in Sri Lanka. This research also found a high potential of cross resistance development in Sri Lanka for commonly applied fungicides. Due to high potential of cross resistance development, farmers should be careful in choosing fungicides and field sanitation is critical. Infected heads should be destroyed. Deep plowing and burying sclerotia in deep soil will help reducing the pathogen survival.



*Infected cabbage with the head rot pathogen.*



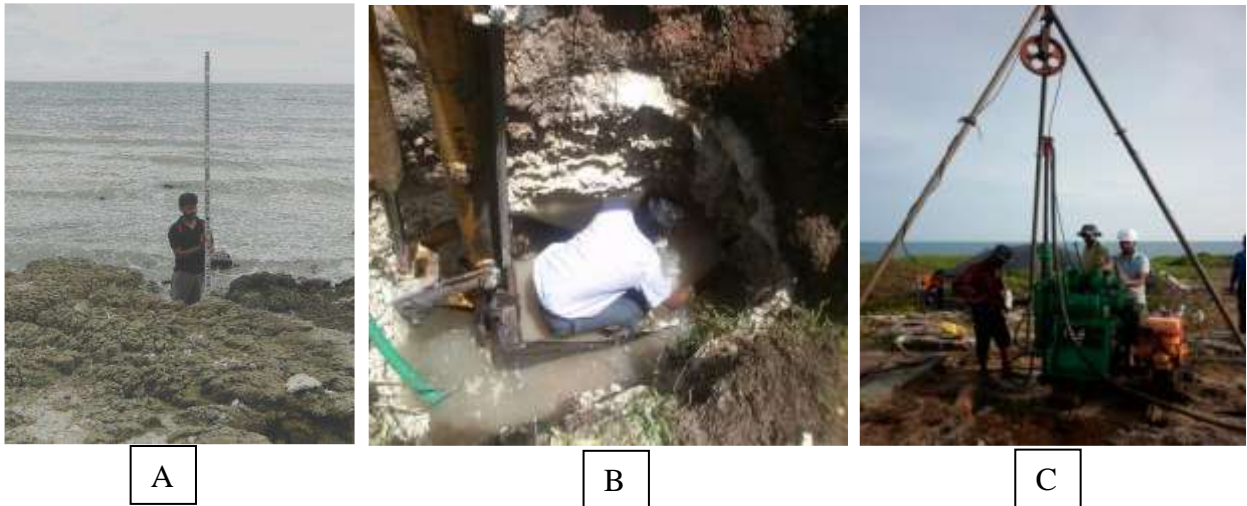
**03. Grant No** : **RG/2014/OMR/01**

**Investigators** : **Dr Pradeep Nalaka Ranasinghe**  
University of Ruhuna  
**Dr W K B N Prame**, Geological Survey and Mines Bureau,  
**Dr Terney Pradeep Kumara**  
General Manager/Chief Executive Officer  
Marine Environmental Protection Authority, Colombo 09  
**Commodore Y N Jayaratne**, Sri Lanka Navy

**Project Title** : **Constructing quaternary sea level curve for Sri Lanka**

Understanding long term sea level variability is key to recognizing future variability. Main objectives of the research were to contribute to developing a long sea level record for the Central Indian Ocean and identification of forcing mechanisms.

According to the results, three phases of island formation during the Miocene, Pleistocene, and Holocene could be recognized in the Palk Strait area. Changes in sea level have resulted in these island formations. It was recognized that future anthropogenic sea level rise could submerge a large area of coastal lowlands in the south and in the Jaffna peninsula. This study also glimpsed the coastal landscape changes at the anthropogenic sea level rise. According to the gathered data, coastal lowlands including Jaffna peninsula will be at risk with the rising sea level. This information can be used for urban planning and coastal zone management. Modelling the coastal areas with accurate leveling data is essential to predict flooding areas at different levels of sea level rise in future.



*Figure 1: A - Measuring the height of the sampled in-situ coral heads; B - Studying buried corals at Polhena; C - Rotary core drilling of coral and Limestone basement at Kachchativu Island*

- 04. Grant No** : **RG/2014/HS/04**
- Investigators** : **Prof. Sunil Premawansa**  
University of Colombo  
**Prof. Shiroma Handunnetti**  
IBMBB, University of Colombo  
**Dr Dharshan De Silva**, GeneTech Research Institute,  
**Dr Gayani Premawansa**, North Colombo Teaching Hospital
- Project Title** : **Studies on prognostic markers of oxidative stress and its host genetic polymorphisms and endothelial dysfunction in severe dengue infection**

This study was conducted to assess serum biomarkers for early detection of severe dengue infection and to understand the pathological mechanisms involved. Several potential biomarkers were identified through the study. Serum NOx levels in the early stages of the disease was identified as a prognostic indicator.

- 05. Grant No** : **RG/2014/HS/06**
- Investigators** : **Dr Suranga Kodithuwakku**  
University of Peradeniya
- Project Title** : **Effect of endocrine disruptor Mancozeb on Oviductal/ Fallopian tube proteome and secretome**

Mancozeb is a fungicide, which is very commonly used in Sri Lankan agriculture sector. Recently, based on scientific evidence, Mancozeb has been identified as an endocrine disrupting chemical. In Sri Lanka, Mancozeb use is very high and quite often the farmers misuse it and heavy doses of Mancozeb gets into the environment. Endocrine disruptors have been alleged as one of the causes of sub fertility and infertility which is increasing all over the world. This study was conducted to find the effect of Mancozeb on the oviduct/ fallopian tube.

*In-vitro* cell culture based assays and *in-vivo* mice studies were carried out and the data suggest a direct disruptive impact on oviductal functions. Hence, Mancozeb was found to cause the loss of pregnancy leading to sub fertility and infertility.

06. Grant No : RG/2012/HS/02

Investigators : Prof. Jennifer Perera  
Dr N. V. Chandrasekharan  
University of Colombo

Project Title : Identification of clinically significant Mycobacterium other than tuberculosis (MOTT) species, assessment of *in-vitro* drug susceptibility, development of a rapid ELISA based identification method

Non-tuberculosis Mycobacteria (NTM) causes pulmonary disease which is often chronic and occurs in older people or those with underlying lung diseases. More attention is always paid to the diagnosis of diseases caused by *M. tuberculosis* complex. However, there are increased numbers of reports of infections caused by NTM. Therefore accurate identification of species is vital for individual patient management with correct antibacterial treatment.

Seventy eight NTM were identified from the specimens. Antibiotic susceptibility testing was also carried out and drug resistance was identified. Further work is being carried out to develop an assay for identification of NTM.

07. Grant No : RG/2014/EB/03

Project Title : Assessment of potential human and ecosystem health risk imposed by atmospheric particulates in Kandy, Sri Lanka

Investigators : Dr Meththika Vithanage, National Institute of Fundamental Studies  
Dr A.M.M. Ziyath, University of Peradeniya  
Dr Dammika Magana-arachchi, Institute of Fundamental Studies

This study is focused on different types of pollutants, inorganic, organic and biological. The results indicated pollution of Kandy City by heavy metals (HMs), microbes and Polycyclic aromatic hydrocarbons (PAHs). There is a risk associated with children exposed to HMs. Further studies are required on how to mitigate and the control this pollution. Therefore results of this study lead the pathway for researchers to plan and implementing pollution mitigation actions. There was no any research conducted so far regarding atmospheric microorganisms in Sri Lanka. The study will be an initiation for the scientific population in Sri Lanka to gather knowledge on diversity, quantity and risk due to microbial pollution in atmosphere. Knowledge regarding the status of the atmosphere at a typical hill country city in a developing region in terms of pollutants is disseminated to the scientific community and general public through the publications.

The study shows how the Heavy metals and Polycyclic aromatic hydrocarbons are presence in Kandy atmosphere. The pollution conditions are always suppressing the national/socio-economic development. As the Kandy City having historical and religious importance, the atmospheric pollution will influence tourism industry in a negative way. The revealing of pollution status for make the necessary actions to mitigation of pollution status will significantly help to national/socio-economic development. The data is useful in reducing health related impacts to the community via atmospheric particulate bound pollutants, which will lead to reduce the associated health cost. This can be used as a baseline study for proposing a better traffic plan for the Kandy area.

**09 Grant Number : RG/2014/EB/01**

**Title of the Project : Purification of graphite of Sri Lanka as a high value addition**

**Principal Investigator : Dr. (Mrs) I.R.M.Kottegoda**  
Ms. J.T.S.T.Jayawardane  
H.C.D.P Colombage  
Industrial Technology Institute

The method of purification of Graphite utilized in this project is called as acid/alkali method. In this method, impurities are reacted with NaOH and H<sub>2</sub>SO<sub>4</sub> causing it to turn to soluble chlorides and sulphates washed with water and remove it. This method has less investment and it is easy to be implemented.

The purified graphite are widely applied in manufacturing of highly value added materials such as graphite oxide, reduced graphene oxide and the value of graphene prepared from high purity graphite exceeds the value that is made out from natural graphite. Beneficiation of graphite concentrate to a 99%-plus purity level is essential for use in lithium-ion batteries and for other high technology applications. For example, semiconductor technology demands constant innovation and ultra-high-purity materials from suppliers. Products made from high-purity fine-grain graphite meet these requirements. Development of materials for wafer production processes and coatings enhance the purity of the next semiconductor generation, while extending the service life of materials at the same time. The results will lead to technology transfer of the invention to the natural graphite exporters in Sri Lanka and innovative materials and processes are patented.

Proposed research would lead to widening of the different field of manufacturing industry such as carbon based materials producers, primary and secondary battery producers and fuel cells, friction materials, carbon brushes for electric motors, refractory, lubricants and iron powder metallurgy.

Human Resource capacity building in the area of advanced materials will lead our nation to come forward similar to the way that Singapore, Korea have developed today who were well behind Sri Lankans economy in three decades back. The final output of the project and the Technological Knowhow will be disseminated to the general public and scientific community by research publications and presentations. New industries with new job opportunities will be created through production of high purity graphite for export purpose.

## Highlights of Completed Grants 2019

1. **Grant No** : **RG/2015/ EA & ICT/02**
- Investigators** : **Prof. R U Halwatura** , University of Moratuwa
- Project Title** : **Investigation of mud concrete for in-situ cast load bearing walls**

Mud-Concrete is a sustainable, novel earth-based walling material developed by Prof. Rangika Halwatura (**Principal Investigator**) and Dr. Rizna Arooz (**Research Student**) at the Faculty of Engineering, University of Moratuwa, through the grant RG/2015/EA&ICT/02. It is a mixture of soil, cement as a stabilizer in very low quantities and water. The precise gravel percentage governs the strength of the Mud-Concrete. Most importantly, the introduced self-compaction method brings solutions to remove the labour intensive construction methods and control the cost, quality and time during construction. This novel walling system was patented under Sri Lankan property act No.36 of 2003 (Patent Number: 18762/ International patent classification: E04C1/00). This technology is currently being used in the construction industry and CSR projects in Sri Lanka.



*Assembling the formwork-Process of in-situ cast Mud-Concrete wall construction*



*Prototype in-situ cast Mud-Concrete load-bearing wall models made for laboratory testing*

2. **Grant No** : **RG/2016/OMR/01**
- Investigators** : **Dr M. D. S. T. de Croos**, Wayamba University of Sri Lanka
- Project Title** : **Taxonomical Identification and Present status of Jellyfish resource in the coastal waters of Sri Lanka**

First ever comprehensive study on Jellyfish resource in Sri Lankan waters was conducted by, **Dr M D S T de Croos** (Principal Investigator) and Mr Krishan Karunarathne (Research Student), of Department of Aquaculture & Fisheries, Wayamba University of Sri Lanka under the grant **RG/2016/OMR/01**. The study resulted in reporting 43 jellyfish species out of which 23 have been reported for the first time from Sri Lankan waters. Further, 8 new species have been recorded as an outcome. In addition, distribution and abundance of each jellyfish has been mapped with respect to different seasons. With the records of previous studies, a check list of 150 species of jellyfish from Sri Lankan waters have been developed in this study, which happens to be the very first of its kind in Sri Lanka.



**Figure 1:** A potentially exportable species (Sand-type jellyfish) for edible purpose.



**Figure 2:** A commonly occurred hazardous jellyfish species (Portuguese man of war) along the southwest and northeast coasts during respective monsoonal periods.



**Figure 3:** An ornamentally valuable species (Australian spotted jellyfish) found in northeast coast of the country.



**Figure 4:** A fisherman is carrying a giant, edible species (white-type jellyfish).



**Figure 4:** Upside-down jellyfish found in Jaffna Peninsula (as a good bio-indicator for water pollution and as an ornamental species)

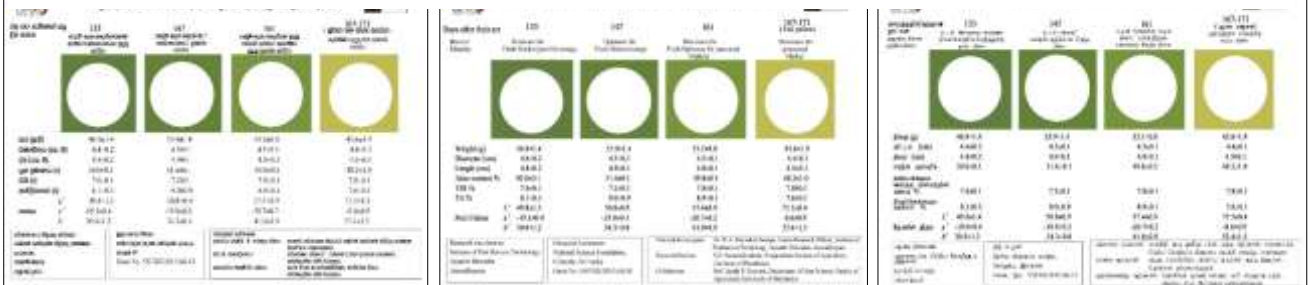


**Figure 5:** Ball-type jellyfish which is currently exported from Sri Lanka in bulks.

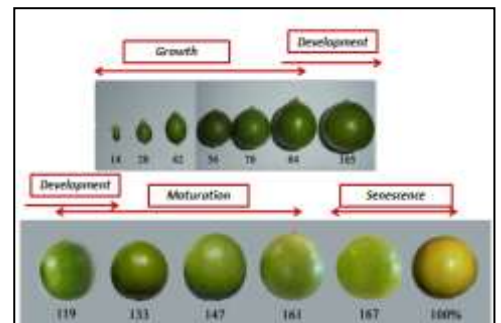
3. **Grant No** : **RG/2015/AG/01**
- Investigators** : **Dr(Mrs)WA. Harindra Champa**  
Dr.BMKS. Tilakaratne  
Institute of Postharvest Technolog
- Project Title** : **Investigation of fruit phenology and preharvest foliar treatment of growth regulators on fruit quality and post harvet life of lime (Citrus aurantifolia Swingle)**

A Competitive Research grant (RG/2015/AG/01) in the discipline of Agriculture and Food Science resulted in developing a color chart that can be used by lime growers to identify the best harvesting maturity based on the peel color. This will aid in fetching a better market price and maintaining fruit quality for an extended time period. The grant was awarded in to Dr W.A. Harindra Champa of the Institute of Postharvest Technology and the study was carried out with the aim of studying fruit phenology, maturity manipulating, fruit season and development of appropriate storage strategies for year-round marketing.

Fig. 1: Colour Charts developed in all three languages; Sinhala, English, Tamil



The study resulted in finding optimum harvest maturity for fresh market and storage purpose and the optimum doses of pre-harvest foliar sprays of gibberellins, brassinosteroids and salicylic acid to advance, accelerate or delay the development stage of lime. These major findings are directly beneficial to lime growers in Sri Lanka which can aid the development of lime-based agribusiness leading to generation of employment opportunities.



4. **Grant No** : **RG/2014/BT/03**
- Investigators** : **Dr Charitha Lakshini Goonasekara**  
Dr Prasad Premaratne  
Prof. Roshan Perera  
General Sir John Kotelawala Defense University
- Project Title** : **Development of a vaccine candidate with a broadly reactive neutralizing immune response against dengue**

An effective vaccine for dengue is currently a priority need worldwide. However, the development of anti-dengue vaccines is challenged by the observed high variation in immune response against infection by different dengue virus (DENV) serotypes or their genetic variants. These immune responses are non-neutralizing and at the same time disease enhancing. This study proposed an alternative strategy to the commonly used tetravalent-type vaccine design strategy to focus on conserved epitopes. Research work was carried out at General Sir John Kotelawala Defence University by a three-member research team which

consisted of Prof. Charitha Goonasekara (**Principle Investigator**), Dr Prasad Premarathe (**Co-Investigator**) and Dr Mahesha Nadugala (**Research Student**)

The research was successfully completed with 3 articles in peer-reviewed index journals and 2 national patents. The research team was able to identify five dengue protein epitopes, which were conserved, broadly immunogenic and neutralizing for the 4 dengue serotypes, demonstrating that those to be good candidates for an epitope-based vaccine against dengue. The investigators have already taken the initiative for the next phase of the project, which is to develop this vaccine construct. The project further identified several other dengue protein epitopes, which are ideal markers in the diagnosis of dengue infection, which are already in the process of being developed into a commercializable rapid diagnostic kit.

## 5. Milestone for Safe Biotechnology Research in Sri Lanka

“National Biosafety Project”

As signatory body to Cartagena Protocol, Sri Lanka developed National Biosafety Framework and National Biosafety Policy in 2005. Following that, the current project “Implementation of the National Biosafety Framework in accordance with the Cartagena Protocol on Biosafety”, known as “National Biosafety Project” is being implemented by the Ministry of Mahaweli Development and Environment (MoMDE) along with Food & Agriculture Organization (FAO) of the United Nations, Sri Lanka. The project consists of four components among which component two and a part of component four are technically supported by NSF which was initiated on March 2019.

Component two focus on formulating guidelines for Risk assessment of GMOs, contained use of LMOs/GMOs and feed and food safety, while the component four aims to produce awareness materials on biotechnology & biosafety. Each component has an international consultant, national consultants and working group members, who works together on various objectives like formulating the guidelines, training manuals and preparing awareness materials with the support & coordination from NSF. The components are handled by groups of experts from various national institutes.

NSF has conducted various technical meetings and workshops to formulate the guidelines and has prepared few outreach materials for professionals.

The draft guidelines have been submitted the MoMDE and more awareness materials are being produced for various target groups.





- 01. Grant No. :** **RG/2016/AG/02**
- Principal Investigator:** **Dr (Mrs) Ilmi Hewajulige**  
Industrial Technology Institute, Malabe
- Project Title :** **Biodiversity and technological potential of micro-flora from selected Sri Lankan dairies**

Dairy foods offer a significant promise in reducing malnutrition in many communities in the world. Microbial diversity of dairy environments presents an enormous, largely unexploited genetic and biological pool that could be utilized for the recovery of new strains. Preserving and controlling the microbiological quality of raw milk is a worldwide concern, however, only a few studies have examined the bacterial biodiversity of raw milk and many questions exist as to their role in health and disease. In this backdrop, a study was carried out to investigate the microbial diversity of raw milk produced in Sri Lankan dairies and to correlate the findings with hygienic conditions and milking practices. In fact, this was the first study carried out on the microbial biodiversity of Sri Lankan dairies which generated a whole profile of the existing microbial communities in raw milk. From over 1825 different isolates obtained, 12 Lactic Acid Bacteria and 20 Yeasts possessed strong probiotic properties and were safe for live consumption. In addition, the pool of isolates comprised of potent candidates with antimicrobial, cholesterol lowering, exopolysaccharide producing, amylolytic and milk technological properties and therefore, could be utilized for functional food formulations.

Furthermore, the beneficial microorganisms with functional and industrial potentials isolated and identified from this study has laid foundation for the establishment of Sri Lanka's first depository of authentic dairy microbial cultures for research and industrial applications within the Food Technology Section of the Industrial Technology Institute.



- 02. Grant No:** **RG/2017/AG/02**
- Principal Investigator:** **Prof. C V L Jayasinghe**  
Wayamba University of SL.
- Project title:** **Industrial fruit waste derived ingredients for commercial food production.**

Generation of large quantities of waste in the fruit processing industry (peels, fleshy parts, seeds, bagasse, etc) is becoming a huge problem to the industry. In this context, a study was conducted aiming at investigating the potential for utilization of fruit waste for product development and value addition. Among many products developed successfully, few are mentioned below:

1. Mango peel-based vinegar production process
2. Pectin extraction processes from lime, banana and mango peels were developed and optimized. Fat replaced ice cream was developed using extracted pectin
3. Pineapple bagasse-based muffin and milk based dietary fiber enriched cookie

Many of the products are ready for commercial scale production, while pineapple bagasse powder enriched muffin production is already done in commercial scale under the brand name "Wayo Food".



Natural Pectin incorporated Ice Cream



Mango Peel vinegar



Dietary fibre enriched milk cookie



Pineapple Bagasse Enriched Muffin



**03** Grant No. : RG/2015/EA&ICT/01

**Principal Investigator** : **Prof. R Shanthini**  
University of Peradeniya

**Project Title** : **Optimization of the processing parameters used in the traditional sesame oil production unit (sekku) and in the screw – press oil expeller used in Sri Lanka [to enhance the quality and the consistency of the quality of sesame oil produced]**

Major objective of this research was to identify parameters that help in enhancing the quality of sesame oil produced in Sri Lanka and such research had never been undertaken. This research has proven that oil quality parameters of Domestic Screw Expeller (DSE)-extracted and sekku-extracted crude sesame oil comply with oil quality standards. DSE and sekku are mechanical devices producing sesame oils without the application of heat. Seeds were prepared by traditional/mechanical means of dry cleaning, washing with water (in some cases) and solar drying and oil was clarified by gravity settling. The said features render Sri Lankan sesame oils to be categorized as virgin or cold-pressed oils which has better market value. This research clearly demonstrated that FFA of freshly extracted sesame oil sample depended heavily upon the freshness of seeds and the storage history of seeds concerned, irrespective of the seed type and oil extraction equipment used.

**04.** Grant No. : RG/2017/EA&ICT/01

**Principal Investigator:** **Dr H M I Prasanna**  
Sabaragamuwa University of Sri Lanka

**Project Title** : **Development of a unified vertical reference framework for land & hydrographic surveying in Sri Lanka**

The aim of this research was to develop a vertical separation model to define the relationship between the geoid, the land surveying height datum (reference surface) and hydrographic datum (chart datum) of Sri Lanka. Currently, a proper geoid model is not available for Sri Lanka. This is a major drawback for effective surveying activities (levelling) in the country. In this research, a reasonable geoid model was determined using a high resolution GGM and accurate topographic data. This can be further developed in future by incorporating latest gravity based models and terrain data.

05. Grant No. : RG/2015/BT/05

Principal Investigator : Prof. Janakie P. Eeswara, University of Peradeniya

Project Title : **Biochemical and molecular characterization and rapid multiplication of 5 selected accessions of *Aegle marmelos* (Lin.) Correa (Bale)**

Bael (*Aegle marmelos* L.) possesses exceptional values as a medicinal fruit tree species. The present study addressed the need of filling the knowledge gap which is a barrier in the process of developing bael as a profitable cash crop in the country. The five elite mother plants, selected by the Fruit Crop Research Development Institute (FCRDI) of the Department of Agriculture Sri Lanka, namely *Beheth Beli* (BB), *Mawanella* (MA), *Paragammana* (PA), *Polonnaruwa Supun* (PS) and *Rambukkana* (RA) were used as the experimental materials. The fruit morphological diversity, genetic diversity using SSR and ISSR markers, chemotaxonomic structure, anti-oxidant and antibacterial properties were assessed.



*Variation of the fruit morphology in five bael accessions.*

The representative fruit images and their cross sections are shown side by side.

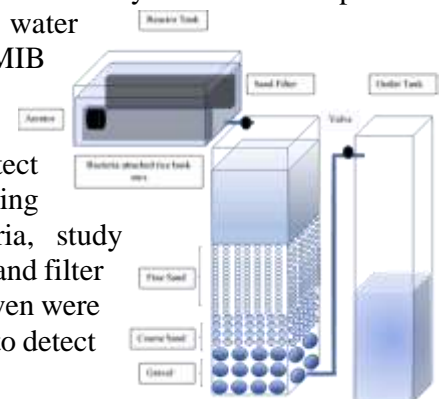
- A: *Beheth Beli* (BB),
- B: *Paragammana* (PA);
- C: *Mawanella* (MA);
- D: *Rambukkana* (RA);
- E: *Polonnaruwa Supun* (PS)

06. Grant No. : RG/2016/EB/04

Principal Investigator : Prof M. M. Pathmalal  
Dept. of Zoology, University of Sri Jayawardenepura

Project Title : **Detection and removal of geosmin and MIB (2-methylisoborneol) in drinking water by native bacteria; bioremediation approach for green solution**

A major concern of water treatment utilities worldwide is the off-flavours in drinking water. Different types of compounds have been identified as causative agents of off-flavours in water. The most prominent ones are geosmin and 2-Methylisoborneol (2-MIB), which are produced by microorganisms; algae, cyanobacteria, bacteria, fungi and actinomycetes. The compounds can be detected by human nose at parts per trillion level and human threshold level is 5 ppt. The conventional water treatment methods have failed to remove the dissolved extracellular 2-MIB and geosmin and boiling at 100°C fail to remove Geosmin and 2-MIB from drinking water due to their thermal stability. Hence, the objectives of the present study were establishing a cost-effective method to detect Geosmin and 2-MIB, to identify Geosmin and 2-MIB producing cyanobacteria, isolation of Geosmin and 2-MIB degrading bacteria, study degradation kinetics of Geosmin and 2-MIB and establishing a lab scale sand filter to remove Geosmin and 2-MIB from drinking water. All the objectives given were achieved during the study period and a modified method was established to detect Geosmin and 2-MIB in water for the first time in Sri Lanka.



*Structure of the laboratory scale sand filter*

07. Grant No. : RG/2017/ BS/02

Principal Investigator: Prof. G A K S Perera, Wayamba University of Sri Lanka

Project Title : **Synthesis and characterization of ionic liquid based gel polymer electrolytes to be used for rechargeable cells and supercapacitors**

Demand for rechargeable cells and super capacitors is increasing at an alarming rate due to escalating use of various devices that require uninterrupted power. At present, rechargeable cells and super capacitors are being deeply integrated into a large number of areas such as transport, health and industries. However, if their safety issues are not addressed properly, flora and fauna around the globe may face serious threats in the near future. In this project, the research team aimed to develop rechargeable cells and super capacitors using non-toxic materials for the electrodes and electrolyte. Mainly, electrolyte was prepared in semi-solid state using user friendly materials. They consisted of a polymer, a salt and an ionic liquid. The special feature of these electrolytes is that apart from semi-solid nature, they were not having any plasticizers which are very toxic in nature. In place of plasticizers, ionic liquids were incorporated for electrolyte preparation. Electrodes were based on non Li metals as well as natural graphite and conducting polymers. This is the first research project carried out in Sri Lanka to fabricate non Li rechargeable cells and super capacitors using ionic liquid based polymer electrolytes and natural graphite electrodes. The developed electrode materials and electrolytes exhibited appreciable electromechanical properties. Their performance was further optimized by varying the compositions. Device fabrication and characterization were also done with suitable methodologies. Many rechargeable cells and super capacitors fabricated under the project possess promising performance including durability to be used for applications upon further modifications.



Figure 1: Ionic liquid based polymer electrolyte



Figure 2: Natural graphite based electrodes

08. Grant No. : RG/2016/ BS/02

Principal Investigator : Prof. Anura Wickramasinghe  
Dept. of Chemistry, Faculty of Science, University of Peradeniya

Project Title : **Synthesis of biologically active natural product libraries of 3β-[α-L arabinopyranosyl]olean-12-en-28-oic acid**

In this study, 23 natural library derivatives of the natural saponin have been prepared. Structural analogues of a triterpenoid saponin; 3β-[α-L-arabinopyranosyl]olean-12-en-28- oic acid (APOA) were synthesized by functional group modifications of sugar hydroxyls, C-12 olefin and the C-28 carboxylic acid group of APOA and their structures were confirmed by spectral data. Comparative cytotoxic efficacies of the analogues were assessed against the APOA using Sulforhodamine B (SRB) assay. Sterically and electronically different types of ester derivatives were synthesized at C28 COOH of the APOA, with and without acetate protection of sugar hydroxyls. Further, C12- double bond was oxidized using two different conditions to provide C12 keto compound and the C11 α, β unsaturated ketone. In addition, ethyl ester of the APOA was also oxidized under two conditions. C28- COOH fluorination was performed to produce COF acetyl fluoride compounds. Moreover, COF compound with OAc protection at sugar hydroxyls was also oxidized under two conditions. Among all the compounds, C28 COF, C12 carbonyl containing oxidized product has shown much better anticancer activity than the original compound. The anticancer activity of most of the synthesized compounds are comparatively less than the original compound, however, they have shown a significant activity (LC50 < 20ppm) on lung cancer cell lines. It is believed that further modifications could result in more potent compounds.

9. **Grant No.** : **RG/2015/HS/01**
- Principal Investigator** : **Prof. Preethi V. Udagama**  
Department of Zoology, Faculty of Science, University of Colombo
- Project Title** : **Proliferative, differentiation and toxicological effects of selected herbal / sponge extracts tested on in house established mesenchymal and haematopoietic stem cell lines**

Human stem cells (HSC) are a group of cells in our body with the ability to increase in numbers and to turn into many different cell types. HSCs can replace dying/damaged and non-functional cells in regenerative medicine therapy. As HSCs are found in most tissues in small numbers, obtaining sufficient number of cells for treatment remains an issue. Synthetic HSC stimulants are available to increase cell numbers under laboratory conditions as well as within the body. Due to exorbitant pricing, side effects and toxic issues related to these synthetic stimulants, it is important to search for affordable, non-toxic, natural stimulants with no side effects, which would specially benefit the developing world.

Therefore, this study focused on screening herbal preparations of traditional medicine to seek the possibility of using plant derived natural chemicals as stem cell stimulants. Two types of stem cell lines were established in the laboratory using waste from childbirth: human mesenchymal stem cells (hMSCs) from the umbilical cord, and human blood (haemopoietic) stem cells (hHSCs) from cord blood. The experiments identified that 2 of these herbal preparations increased cord tissue stem cell numbers, while all 3 increased cord blood stem cell numbers. In addition, one of the preparations turned cord tissue stem cells into cartilage cells, reduced fat content in fat cells and showed an anti-obesity (weight loss) effect in a rat model. If further analyzed and standardized, these preparations can be commercialized as three separate non-toxic, low cost, stem cell stimulants, a novel anti-obesity drug, and a stimulant to regenerate cartilage cells.



*Human mesenchymal stem cell (hMSC) line derived from umbilical cord*

10. **Grant No.** : **RG/2016/HS/04**
- Principal Investigator** : **Dr Nilupa R. Amarasinghe**  
University of Peradeniya
- Project Title** : **Investigation of acetylcholine esterase inhibitory activity of Sri Lankan grown spices as potential therapeutic agents for Alzheimer's disease**

Alzheimer's disease (AD) is the most common age related neurodegenerative disease and has become the leading cause for dementia. Dementia has long been considered an inevitable part of ageing, but recent findings have shown onset of neurodegenerative disorders like AD in the latter part of the life can be controlled by having healthy fruits and vegetables.

Spices have a long history in traditional medicine and are vital component in everyday meals in Sri Lankan society. This study investigated local spices for their potential health benefits including their ability to slow

down the memory impairment in patients with AD. Out of the twelve spices subjected to testing, mace (fruit aril of nutmeg, Vasa-vasi; Sinhala, Saadikai-thol; Tamil) had a very good anticholinesterase activity indicating its potential application to treat AD. The active compound was identified as malabaricone C. Available scientific literature and these findings have shown that mace has promising activity against neurodegenerative diseases through multiple mechanisms.



*Nutmeg and mace*

- 11. Grant No.** : **RG/2016/OMR/01**
- Principal Investigator:** **Dr M. D. S. T. de Croos**  
Wayamba University of Sri Lanka
- Project Title** : **Taxonomical identification and the current status of jellyfish resource of the coastal waters of Sri Lanka**

Researchers attached to the Department of Aquaculture and Fisheries at the Wayamba University of Sri Lanka have discovered as many as eight new jellyfish species, and one of them has been named “*Carybdea wayamba*” to honor the Wayamba University of Sri Lanka. *C. wayamba* is known to be the first jellyfish species introduced by Sri Lankans. The discovery was the result of the first-ever systematic survey carried out on pelagic gelatinous fauna in Sri Lankan waters. Not only the new species, but this study has also resulted in twenty-five first time recorded jellyfish species from Sri Lankan waters. Some taxonomic results of the study have already been published in different journals and the rest will be published soon. An annotated checklist of jellyfish, containing around hundred species reported from Sri Lankan waters will be published in the upcoming National Red List of Sri Lanka.



*Carybdea wayamba*

- 12. Grant No.** : **RG/2017/IK/01**
- Principal Investigator** : **Prof. Raj Somadeva**  
Postgraduate Institute of Archeology
- Project Title** : **Human adaptations in the Middle Holocene in Sri Lanka and further techno-cultural development towards formative historical period**

This research project addressed human existence and its continuity in Sri Lanka during the Holocene geological epoch. Early presence of humans in Sri Lanka during the middle and late Pleistocene has already been proven by archaeologists and physical anthropologists. However, the continuum of their existence towards Holocene has not been scientifically questioned.

Under this research project six prehistoric caves were archeologically investigated by a team of archeologists headed by senior Prof. Raj Somadeva under a project funded by the NSF, to obtain material evidence to affirm the techno-cultural characteristics of the Holocene.

Most striking evidence unearthed was a collection of plant residues (charred seeds) that has been dated to the mid-Holocene (4500-3450 BCE) suggesting an emergence of a new cultural behavior by the Holocene hunter-gatherers. These specimens were excavated from Lunugalge (Figure 1) and Alugalge rock-shelters.

Excavated samples including wild millets (Figure 2), other plant materials, grindstones and some beads made out from animal teeth and bones (Figure 3) were dated around 3500 to 5000 BCE. Evidence reflecting an emerging new materiality of those prehistoric communities was identified. The sites and the artifacts together with Carbon-14 dates reiterate the fact that the hunter-gatherer/foragers of the mid/late Holocene had been receptive to the climatic changes of the contemporary period and the adaptive response is reflected in their material culture.



**Figure 1: A view of Lunugalage rock shelter excavated in Ilukkumbura. It was partly dug out by treasure hunters**



*Figure 2: One of the excavated seeds identified as the variety of Oryza sp. (× 40)*



*Figure 3: Some prehistoric beads made out from animal teeth and bones recovered from the excavation at Alugalge rock shelter (Cal. BC 3505 to 3452)*

## Highlights of Completed Grants 2021

1. **Grant No.** : **RG/2016/BT/03**
- Principal Investigator** : **Dr A. Arulkanthan**, University of Peradeniya
- Project Title** : **Studies on mycobacteriosis in freshwater ornamental fish: Identification of risk factors, and clinic pathological features and development of rapid diagnostic technique**

Piscine mycobacteriosis is a chronic, systemic disease affecting many species of ornamental fish. Upon infection, the mycobacteria invade and multiply in many internal organs of the fish including liver, spleen and kidney, and induce the formation of greyish-white or yellowish-white coloured nodular structures (technically known as granulomas) in the above organs. The main objectives of this study were to identify the mycobacterial species occurring in ornamental fish (gold fish, koi carps, guppy, molly, platy) in Sri Lanka and to develop a molecular diagnostic technique. This study revealed that *Mycobacterium* spp. especially *M. fortuitum* is widespread among ornamental fish species in Sri Lanka. The Internal Transcribed Spacer (ITS) PCR validated in this study could be used as a rapid laboratory diagnostic tool to detect mycobacteriosis in fish. As a national service to ensure the ornamental fish health in order to uplift the ornamental fish sector in Sri Lanka, the diagnostic techniques validated in this study are made available in the Centre for Aquatic Animal Disease Diagnosis and Research (CAADDR), University of Peradeniya for the government and private sector, farmers, aquarium owners and general public.



Figure 01: Greyish-white or yellowish-white coloured nodular structures

2. **Grant No.** : **RG/2016/BT/04**
- Principal Investigator** : **Prof. Ranil Dassanayake**  
University of Colombo
- Project Title** : **Transgenic reconstitution of RNA interference pathway in *Pichia pastoris* yeast model system**

RNA interference (RNAi) mechanism is a novel homology dependent gene regulatory pathway found in most eukaryotes which activates sequence-specific RNA degradation process, and induced by double stranded RNA (dsRNA). RNAi pathway was reconstructed in *P. pastoris* by introducing human Argonaute, Dicer and TRBP genes to study the efficacy of *in-silico* designed dsRNA to generate siRNA and identification and down regulation of targets by siRNA, based on the intensity of green fluorescence protein (EGFP) emission, the gene which has also been introduced into the *P. pastoris*. Transgenic *P. pastoris* strain developed in this study can be used to validate how effective the *in-silico* designed dsRNA in the destruction of the target in RNA interference which is otherwise difficult to test in cell cultures due to high cost and time consumption.

EGFP tagged yeast expression vector and the RNAi expressing transgenic *Pichia pastoris* strain will be made available for the R & D sector in Sri Lanka once it is fully established.



Figure 2: *P. pastoris* GS115 colonies transformed with linearized pPICZ A-Gall1-EGFP



3. Grant No. : RG/2017/EB/05

Principal Investigator : Dr N. P. S. Kumburegama  
University of Peradeniya, Peradeniya

Project Title : Distribution of terrestrial gastropod pests, their seasonal abundance and degree of damage to crops in agricultural lands in the Nuwara Eliya district

This study aimed to determine the number of pest gastropod species, their distribution, seasonal abundance and the degree of damage caused by them to agricultural crops in the Nuwara Eliya (NE) district. In addition, the study also aimed to assess the potential invasiveness of these exotic gastropods into natural and semi-natural environments.

A total of 14 species of terrestrial gastropods were identified in agricultural lands. 64% were exotic pest species and 36% were native species. Of the native species, *Macrochlamys indica* and *Cryptozonia chenui* were observed to damage crops. The gastropod species richness, relative abundance and density were significantly high during the wet season. However, egg clutches were found under soil and decaying organic matter during the dry period suggesting that these species breed during the dry period while the young hatch during the wet period leading to sudden increase in the population size. The exotic gastropods were widespread in agricultural lands and they showed a wide range of tolerance to the environmental factors. The seedling stage of leafy vegetables like leeks (*Allium porrum*), cabbage (*Brassica oleracea*) and lettuce (*Lactuca sativa*), rooted crops like carrot (*Daucus carota*) and chillie (*Capsicum annum*) are the most vulnerable to gastropod attacks. While elevation, rainfall and atmospheric pressure were the major governing factors for exotic species, all measured environmental factors affected the distribution of the endemics and native species. Any alteration to natural habitats will therefore adversely affect the native species whereas the exotic species will be favored in such environments. Information on the distribution and abundance of exotic pests and native gastropod species in NE can help formulate management plans related to landscape planning and habitat transformation.

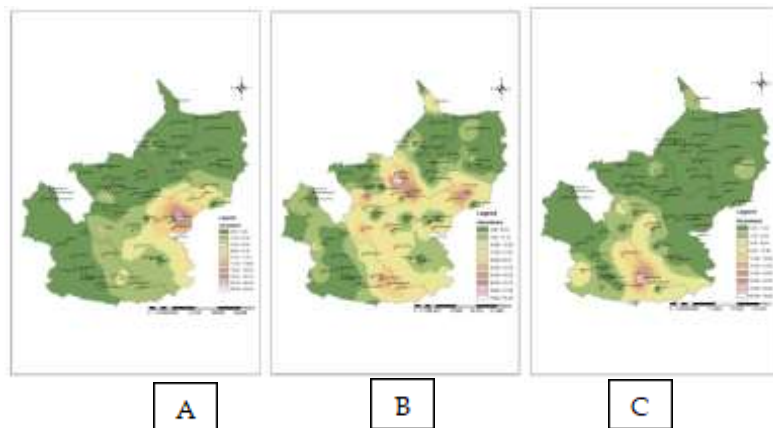


Figure 3: Terrestrial gastropod species distribution in agricultural lands in Nuwara Eliya district. A) Exotic pest snail distribution, B) Exotic pest slug distribution and C) Native species distribution

4. Grant No. : RG/2017/EB/01

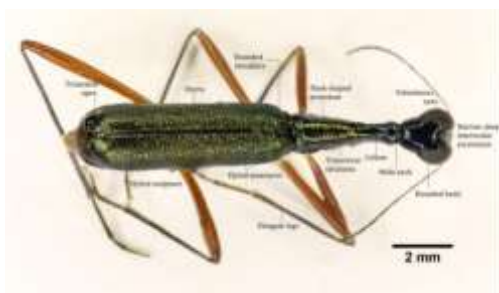
Principal Investigator: Prof. Chandima D. Dangalle  
University of Colombo

Project Title : Diversity, distribution and habitat types of arboreal tiger beetles (Coleoptera, Cicindelidae) of Sri Lanka

Arboreal tiger beetles are a poorly studied group of predatory insects in Sri Lanka. Past literature records 30 species from the island of which 23 species are endemic. However, the literature dates back to more than 100 years and are far outdated. Therefore, current studies on this beetle group with high endemism

was necessary and the present study intended to record the arboreal tiger beetle species of Sri Lanka, their distribution and habitat types. Eighty-five locations within the country including all climatic zones and provinces and 20 districts were investigated and a variety of habitat types were surveyed. A database consisting of arboreal tiger beetle species, their locations of occurrence, environmental parameters of their locations, morphology and morphometrics was constructed and used for developing an automated identification system for tiger beetle species of Sri Lanka.

The study recorded nine species of arboreal tiger beetles from Sri Lanka of which six species were endemic. *Derocrania scitiscabra* was the dominant species encountered in the study and was widely distributed throughout the country. *Tricondyla gounellei* was recorded for the first time in Sri Lanka. Arboreal tiger beetles were found in all climatic zones, provinces and 14 districts of Sri Lanka. Species were found in many habitat types such as agro-ecosystems, forests, woodlands, reservoir banks and home gardens. However, most of their locations were agro-ecosystems which consisted of coconut, tea, pepper, cinnamon, betel and fruit cultivations. An automated system for identifying tiger beetles was developed using habitat, morphological and morphometric data of beetles. This machine learning system was the first system



developed for identification purposes of fauna in Sri Lanka and addressed and overcame drawbacks of using bio-acoustic signals and other sensory data for identification of insects.

Figure 4: Dorsal view of *Neocollyris (Stenocollyris) vedda* Male

5. **Grant No.** : **RG/2016/BS/01**
- Principal Investigator** : **Prof. R. M. G. Rajapakse**  
Dept. of chemistry, Faculty of Science, University of Peradeniya
- Project Title** : **Synthesis and characterization of ionic liquid-based gel polymer electrolytes to be used for rechargeable cells and supercapacitors**

This research project is based on entirely novel concept of using upconverted infrared radiation for developing dye sensitized solar cells (DSCs) that would work only with infrared radiation enabling them to work even in the night. Three different photon upconverting systems were developed through this research project.

System 1: Transition metal ion-doped  $\text{TiO}_2$  - This type of up conversion is not suitable for DSC applications. However, these upconverting catalysts are superior in water photo-splitting to generate hydrogen gas. Therefore, further research into quantification and upscaling of these catalysts should be directed towards generating hydrogen gas for green energy generation.



Figure 5: System 1

System 2: Lanthanide ion-doped  $\text{TiO}_2$  - This is a novel discovery where, for the first time, a solar cell was developed to work only under infrared illumination. This means that our proposal to develop solar cells that would work even in the night is not a myth but is realistic. The concept that solar cells can be developed to work with upconverted infrared radiation was proven through this study.

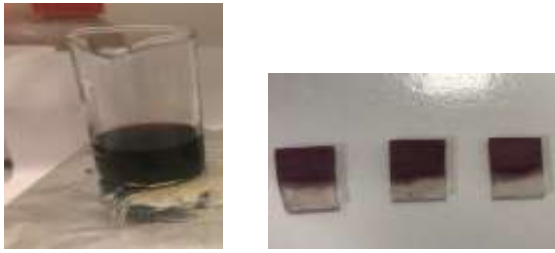


Figure 6: System 2

System 3: Natural dye-based DSCs - This study showed that the DSCs developed using natural dye has highly improved shelf-life and the highest recorded efficiency for this natural dye. Scaling-up of this research is important.

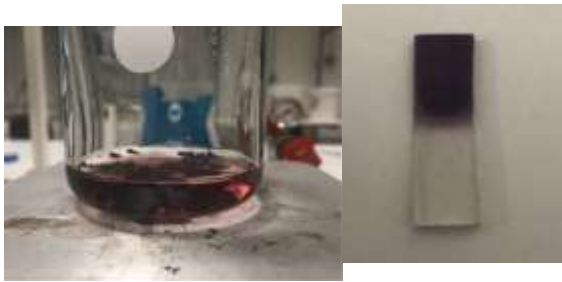


Figure 7: System 3

6. **Grant No** : **RG/2017/AG/04**
- Principal Investigator:** **Dr W. M. P. B. Weerasinghe**  
Veterinary Research Institute, Peradeniya
- Project Title** : ***In-vitro* and *in-vivo* screening of newly introduced forages for sustainable intensification of dairy production in the context of climate change**

Sri Lanka currently imports about 60% of the milk requirement. Poor nutrition of the dairy cows has been identified as one of the major obstacles for dairy development in the country. Available roughage varieties are low in nutritional quality. Additionally, information on their nutritional quality, especially digestibility parameters are lacking or not available. Due to this, proper balancing of dairy cow rations is hard to achieve, resulting in genetic potential for milk production of majority of the dairy herd in the country being not achieved. This project demonstrated that newly introduced fodder varieties (Fodder sorghum Sugar graze, Napier hybrids CO-3 and CO-4) can be effectively used to increase milk production of dairy cows in the country. The nutritive and physical qualities of silages made from three fodder varieties and their Combinations were also evaluated. These findings can be used to produce quality silages for on farm use as well as for commercial silage production. Findings also demonstrated that low fiber, high energy feeds such as sorghum produces less methane than Napier varieties. This crucial information can be used for better feeding and thereby improve production performance of dairy cows while reducing methane production from ruminants. This information can also be used for policy planning on reduction of methane emission by national dairy herd by encouraging low methane emitting roughages to the national dairy herd.



**Figure 8: Chopping grass by grass chopper**



**Figure 9: Feeding of lactating cows**

## Highlights of Completed Grants 2022

1. **Grant No.** : **RG/2017/EA&ICT/02**  
**Principal Investigator** : **Prof. Rangika Umesh Halwatura**, University of Moratuwa  
**Project Title** : **Investigation of alternative stabilizers for soil and develop low cost, eco-friendly load bearing walling material**

Many building materials are imported to the country but are not economically sustainable. Therefore, the country needs to look for affordable building materials that are eco-friendly yet provide suitable structural capacity. Therefore, this research was conducted with the objectives of investigating alternative stabilizers for soil and to develop low-cost, eco-friendly load bearing walling material and development of soil-based wall care putty. The research finding resolve one of the biggest problems by developing a low-cost alternative stabilizer for soil and



Laboratory experiments

soil-based wall care putty using fly ash and bottom ash which are waste products of coal plants and cement plants. The application of these waste materials for any product itself is an economic saving for the country and a mass scale environmental saving to people living in those areas. This project was successfully completed with five journal publications, nine conference publications, a book chapter, four patents: (Fly Ash stabilized mud concrete block for load-bearing walls – 19495, Rubber stabilized earth blocks for load-bearing walls – 19379, Geo-polymerized self-compacting mud block -19567, Soil based wall care putty developed from drinking water treatment plant waste alum sludge – 21020). The products developed during this research has potential to improve as a start-up business with some further developments.



Developed soil-based wall care putty and applications

2. **Grant No.** : **RG/2018/EA&ICT/01**  
**Principal Investigator** : **Prof. M. P. B. Ekanayake**, University of Peradeniya  
**Project Title** : **Development of a novel predictive based Smart Distribution Management System (S-DMS) to maximize the rooftop PV absorption capacity of last mile networks**

In this research, network management strategies executed through a Smart Distribution Management System (S-DMS) that integrates different controllable entities in distribution networks is considered to support these networks thus increasing the Photovoltaic (PV) integration. A novel strategy to minimize unbalance in Low-voltage (LV) networks based on automatic re-phasing of grid-connected rooftop PV systems was proposed with PV re-phasing switch to perform automatic re-phasing of the PV systems. The discrete bacterial foraging optimization algorithm (DBFOA) was introduced to determine the optimal phase combination of grid-connected single-phase PV systems. A three-phase three-limb inverter was hardware implemented and tested. A three-phase four-wire distribution system of 540 m is modeled using resistors and inductors. The proposed method can be tested in a real network with the collaboration of solar panel producers. By convincing the customers about the extra income with the proposed method, they will be persuaded to install rooftop PV systems. This will be both beneficial to the solar panel producers and customers as well as to the environment.



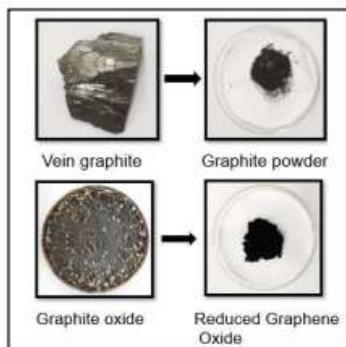
Front panel of the distribution line model designed to test voltage violations and mitigation methods



Fabricated circuit for re-phasing inverter

- 3. Grant No.** : **NSF-PSF/ICRP/2017/EA&ICT/04**
- Principal Investigator** : **Prof. M. A. K. L. Dissanayake** Research Professor, National Institute of Fundamental Studies, Kandy
- Project Title** : **Development of carbon-based nanomaterials for counter electrodes in dye sensitized solar cells**

Under this collaborative project between Sri Lanka and Pakistan, research was focused on developing low-cost, carbon-based materials for counter electrodes in dye sensitized solar cells, to replace expensive platinum-based counter electrodes. Particular attention was given to develop these counter electrodes using naturally occurring Sri Lankan vein graphite. Researchers have developed several carbon-based, low-cost counter electrodes for dye sensitized solar cells using vein graphite/tin oxide nanoparticle composites, reduced graphene oxide and polyaniline embedded tin oxide composites, stainless steel substrate with novel activated carbon and sugar composites. In addition, gel and solid polymer-based electrolytes for these solar cells were developed. These research findings were published in international journals during 2020-2022 period and also formed the major part of a Ph.D. thesis. The research findings on low cost, dye solar cells, successfully proven and validated at laboratory scale, can be further developed through a Research and Development (R&D) phase of about 2-3 years to fabricate practical and prototype dye solar cells and panels. The necessary scientific knowledge and trained scientists are available in Sri Lanka to undertake such a challenge if a government or a private sector agency is prepared to invest the necessary funds.



Prepared graphite powder and reduced graphene oxide from Sri Lankan natural vein graphite

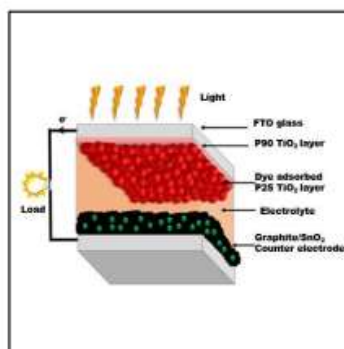


Diagram of a dye solar cell with graphite based counter electrode, fabricated at NIFS.



Counter electrodes for dye solar cells, prepared using activated carbon and sugar composite on conducting glass substrate and stainless-steel substrate

4. **Grant No.** : **RG/2019/BT/03**
- Principal Investigator** : **Dr R. N. Attanayake**, University of Kelaniya
- Project Title** : **Genetic Dissection of polyethylene degradation ability of *Perennipora* sp. isolated from decaying hard woods in Sri Lanka**

This research project was initiated to find a solution for a burning global issue, the accumulation of polyethylene. Previous research findings have reported that fungal depolymerization enzymes play a role in polyethylene degradation. In this project, fungi were isolated from decaying hardwood species from dry zone forests of Sri Lanka rich in decay-resistant hardwoods such as “Kaluwara” and “Burutha”. During the study, eighty-five fungal samples were identified using the latest DNA-based technologies. All the identified species were tested for their ability to secrete economically important polymer degrading enzyme, called “laccase”. The laccase enzyme has a wide range of industrial applications such as: industrial dye decolonization, polymer degradation, paper industry, and many more. The best laccase producers were assessed for their abilities to secrete other polymer degrading biotechnologically important enzymes that have the potential to be used in other industrial applications.

Parallely, the isolates were grown in polyethylene sheet containing media as the only carbon source. Several tests were conducted to determine the level of degradation viz, use of a scanning electron microscope, weight loss, reduction in the strength of the sheets, and changing of chemical properties. A sample isolated from hardwood had a strong potential to degrade polyethylene and it was also capable of utilizing polyethylene as the only C source in the media. 3% degradation was confirmed after the 45-day incubation period. The next step would be to optimize laccase production and characterization and compare it with laccases from other fungal species. The research project was co-funded by the International Centre for Genetic Engineering and Biotechnology (ICGEB) and NSF.



5. **Grant No.** : **NSF -PSF/ICRP/2017/HS/01**
- Principal Investigator** : **Dr Dhammika N. Magana-Arachchi**, National Institute of Fundamental Studies
- Project Title** : **Genetic characterization of drug resistant Mycobacterium tuberculosis isolation from Sri Lankan and Pakistani TB patients and identification of associated biomarkers**

This research project is a collaborative study with Pakistan, intended to identify bacterial mutations that are responsible for drug resistant Tuberculosis (TB). Advanced molecular techniques were carried out to identify common mutations as well as uncommon mutations that circulated within the two countries that could be responsible for drug resistance. As such, more attention needs to be given to the improvement of current diagnostics as there is a chance of false negatives. In addition, the genetic alterations in human blood of drug resistant and sensitive patients were compared using advanced molecular techniques. From Sri Lankan study, a signature panel comprising of 22 markers were identified majority of which are related to immune functions, implying that the immune system of drug resistant patients signals to activate certain immune functions to fight against drug resistant tuberculosis. These markers should be further tested to understand their potential in diagnostics. Further, the researchers were able to develop a rapid and low-cost real-time multiplex PCR (RT-PCR) technique that can be used in a clinical setting for diagnostic purposes of MDR-TB.



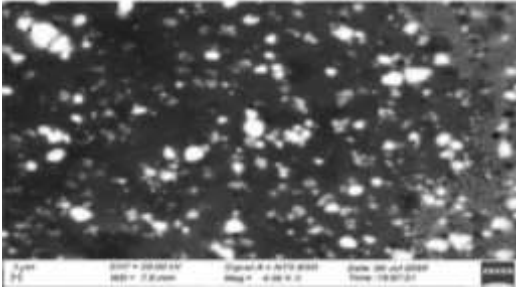
6. **Grant No.** : **RG/2017/BS/05**
- Principal Investigator** : **Dr Mayuri Napagoda**, University of Ruhuna
- Project Title** : **Development of effective sunscreen formulations from Sri Lankan medicinal plants**

Although synthetic sunscreens are widely employed against detrimental effects caused by solar ultraviolet (UV) radiation, the demand for herbal sunscreen formulations has been increasing over the years. Therefore, this study was undertaken to evaluate the suitability of some Sri Lankan medicinal plants to develop as efficacious and safe herbal sunscreen formulations. Six herbal sunscreen formulations were developed by incorporating alcoholic extracts of *Atalantia ceylanica*, *Hibiscus furcatus*, *Leucas zeylanica*, *Mollugo cerviana*, *Olox zeylanica*, and *Ophiorrhiza mungos* into a 100% natural cream base prepared in-house. A similar set of sunscreen formulations were prepared with each of the above extracts, natural cream base, and 5% nano-TiO<sub>2</sub> for comparative purposes. The sun screening potential of all these formulations was evaluated with respect to the SPF (sun protection factor), UV absorption potency, and photostability. The SPF values of all the sunscreen formulations were in the range of 20-28 and were found to be superior to the commercial sunscreen products tested in this study in terms of SPF value and broad-range sun screening activity. All the prepared sunscreen formulations displayed photostability as well as compliance to other parameters of commercial sunscreens. As sunscreen products with SPF values  $\geq 15$ , broad-range UV absorption, and photostability are considered as high-quality sunscreens, all our formulations appear to be promising. Although the incorporation of 5% nano-TiO<sub>2</sub> to the herbal sunscreen formulations resulted in a slight improvement in the appearance of the products, it has not caused a remarkable increment in the sun screening potential of the herbal formulations. Therefore, both sets of sunscreen formulations developed from our study would be suitable for commercialization.





Natural base cream



SME image of nano herbal sunscreen formulation prepared from *L. zeylanica*