3rd Biennial Research Symposium 2017

Energizing Economic Growth Through Science, Technology & Innovation

16 -17 November 2017

PROCEEDINGS

Biennial Research Symposium 2017

Industrial Technology Institute

3rd Biennial Research Symposium 2017

Energizing Economic Growth through Science, Technology and Innovation

Abstracts

16th – 17th November 2017

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Technical Sessions

Message from the Honourable Minister of Science, Technology and Research

It is with great pleasure that I am sending this message for the 3rd Biennial Research Symposium 2017 of the Industrial Technology Institute on "Energizing economic growth through Science, Technology and Innovation". The symposium will be a stage for the ITI researchers to communicate their findings to the general public and also to start a discussion on the way to the future.

During the past few decades we have witnessed major changes in the areas of communication, energy, medicine, agriculture etc. due to the innovations in Science and Technology. These changes have excelled the living conditions of human kind. Thus, Science, technology and innovations play a vital role in the development of the economy of a country.

I take this opportunity to wish all at ITI strength and courage to work towards the betterment of the people of Sri Lanka and also convey my appreciation to the organizing committee of the symposium for their effort to make this event a success.

Susil Premajayantha
Minister of Science, Technology and Research

Message from Secretary to the Ministry of Science, Technology and Research

Since the Industrial Revolution, the growth of economies throughout the world has been driven largely by scientific advances and technological changes. The ability to create, share and search for knowledge has become a major source of competitive advantage, wealth creation and improvements in the quality of life. Some of the main features of this transformation include the rapid application of recent scientific advances in new products and processes, a high rate of innovation among the countries, moving towards more knowledge-based industries and services and attention on skills development.

These changes imply that science, technology and innovation are the keys to improving economic performance and social well-being. Increased competition and globalisation, changes in the drivers of the innovation process, and a better understanding of the role played by science and technology in economic performance are the main aspects the government would focus in energizing the economic growth of the country through science technology and innovation.

It is needless to emphasize the fact that research and development play a significant role in the economic growth of a country. It helps improving the quality of manufacturing. The Industrial Technology Institute has been contributing to our national economy immensely since its establishment through its research and development processes. Moreover, it excels as a centre of excellence in many areas when it comes to research.

Therefore, it indeed is a pleasure to having been able to congratulate on its third Biennial Research Symposium, in 2017. I wish all the best for the organizers and the participants who will be presenting their work at the symposium that would doubtlessly contribute to energize the economic growth of Sri Lanka.

Udaya R Senevirathne
Secretary, Ministry of Science, Technology and Research

Message from the Chairman

It's with great pleasure that I pen this message to the proceedings of the 3rd Biennial Research Symposium of ITI. This year's theme, 'Energizing Economic growth through Science, Technology and Innovation' is very timely as Research and Development and Innovation are the driving forces of Economies of the developed countries of the world.

To elevate the economic status of our country to the next level we have to harness the power of R &D and innovation. Sri Lanka is yet to reach the heights of Research and Development of an international scale. Therefore, research should be promoted and encouraged for more innovative outputs for industrial development and the economy.

Symposiums as this give an opportunity to present and share the innovative ideas among researchers and the society.

I also wish to take this opportunity to thank the organizing committee of the Symposium for their efforts and wish everyone all the very best!

Niroshana Perera
Attorney at Law
Chairman

Message from the Director General

It is with great pleasure that I write this message for the third consecutive Biennium as the Director General of the Institute and the introducer of the "ITI Biennial Research Symposium".

Now the ITI Research Symposium has become one of the biggest events that ITI is organizing in line with the National Science Week which fall from 10th to 17th November each year.

We have witnessed during the past few decades a rapid development in many Asian countries due to the correct utilization of scientific knowledge for economic & social development. For Sri Lanka, the time is ripe to take the same path to develop the economy and to improve the quality of life of our people. As a multi disciplinary research organization, ITI has realized its role in the development of the country. Thus the theme “Energizing the economic growth through Science, Technology and Innovation” was selected as the theme of the Symposium for this year.

In this symposium the stage is set for our researchers to showcase their knowledge based creations to the public. Further the symposium will fulfill two aspects; one is gaining recognition among the scientific community and the second, informing the general public what has been done with the public funds, fulfilling an obligation towards the general public.

This year too we appreciate our Scientists', Engineers' and Technologists' S&T and Academic achievements through a series of appreciation awards. Further, from this year onwards we award a Very Special Award to a citizen or an organization in recognizing the contribution made to the development of Science & Technology Sector in the country.

I take this opportunity to wish my fellow Research Scientists, Engineers and Technologist all the best in all their future Science, Technology and Innovation endeavors.....

"Experimenters are the shock troops of Science" - Max Plank

Dr.G.A.S.Premakumara
BSc, PhD, Dip(Psy), MIChemC, MIBiol, CChem,CBiol, FIBiol
Director General

Message from the Organizing Chair

It is with immense pleasure and honor I welcome the Scientists, Engineers, Technologists and other invitees from Research Institutes, Academia, other Organizations and Industrial Technology Institute (ITI) to the 3rd Biennial Research Symposium of ITI under the theme "Energizing Economic Growth through Science, Technology and Innovation.

The 3rdBiennial Research Symposium, which will be held from the 16 to 17th of November 2017, is a major event of ITI to be staged in Colombo. This event is expected to stimulate and foster the growth of scientific and technology research towards the development of industry. The research symposium will be declared open by Honorable Susil Premajayantha, Minister for Science, Technology and Research as the Chief Guest and Honorable Lakshaman Senewiratna, State Minister of Science, Technology and Researchwill be the Guest of Honour on this occasion.

The technical sessions of the symposium will be held from the 16th to 17th November 2017 at ITI with a special focus on Food, Herbal, Environment, Electro and Material Technology, Industrial Metrology and Biotechnology. Technical Sessions will include plenary lectures from Resource Persons and forty-one technical presentations from ITI research staff.

It will be my pleasure as an organizing chair of the 3rd Biennial Research Symposium participants to use this opportunity to the best, for disseminating their research findings, exchanging contemporary knowledge and building partnerships and collaborations to advance their research, thereby contributing to the national development.

My sincere thanks to Chairman and Board of Management, Director General, symposium Secretary and every member of the organizing committee for making the symposium successful and a memorable event. My appreciation also goes to all the sponsors for their generous financial assistance to glamour this event. I wish all of you a most enjoyable and interactive symposium.

Dr.Radhika Samarasekera
BSc (Hons), PhD (UK), FIChemC, MIChemC, CChem, FIBiol, CBiol, MIBiol
Organizing Chair & Additional Director General – R&D

Plenary Lecture

Pharmacognostical Identification as a Key to Standardization of Herbal Raw Materials

Prof. M. G. Chauhan

Emeritus Professor, Pharmacognosy, University of Gujarat, India

I am grateful to the organizers of the 3rd Biennial Research Symposium for giving me this opportunity of expressing my views on this platform.

The need for authentication of raw herbal drugs, whether in its entire form or parts like the leaf, bark, root etc. or alternatively in its powder form is foremost important criteria in the standardization of herbal drugs.

The drug in the entire form like *Bacopa monnieri, Mentha piperita* etc. either in the fresh or dried condition or from the herbarium sheets of the aerial parts of many can be easily identified with the help of their flowers; it is only when the plants are devoid of flowers, one has to then rely on the microscope for their identification.

Some of the examples of how the authenticity of leaf, bark, seed, root etc. is confirmed by observing their single character under the microscope are stated here. The powder of *Calotropis giantea* and *Calotropis procera* can be differentiated and identified by seeing their laticiferous vessels which, in the former, are branched while in the later are not. Similarly, the leaves of *Melia azedarach* (Mahanimb) show the presence of stellate trichomes that are missing in the leaves of *Azadiracta indica* (Nimb). Likewise, one can notice stone cells and sclereids in *Jasminum auriculatium rachis* which are otherwise absent in *Jasminum grandiflori.*

In *Bauhunia varigata* bark, one finds a cluster of rosette, while its absence is noticed in *Bauhunia purpuria* bark. Fibres are present in *Wrightia tictoria* and other adulterants of *Holarrhena pubescens* (Kutaja), while we find them absent in

the official bark. The root bark of *Gmelina arbora* can be differentiated from its stem bark by the presence of big starch grains which are smaller in size in the stems. Similarly, one finds the presence of scleroids with idioblasts in *Punica granatum* (Dadima) which are absent in the root bark.

Post authentication comes quality detection of the drugs. Majority of the volatile oil containing drugs are often found to be exhausted or devoid of some of their isolates e.g. cal-vone, a ketone fragment of *Dill* fruits is often removed. For such drugs, a proper definition mentioning the presence of the percentage of the particular constituent is essential.

Here, I want to emphasize on the impact on the gender variation on the quality of the herbal drugs. One of the examples which all of us are aware of is *Cannabis sativa* in whose definition is mentioned that the resin is collected from the aerial parts of the plant and not from the male plant, indicating the presence of narcotic resin in the female plant only.

We know how environmental factors affect the quality of the drug but the impact of gender on diocious plants where male and female flowers are borne on different plants is yet not very well investigated. Flower bearing plants like Papaya produce the edible fruits and the enzyme papain which is valued commercially. In cases of Chicken guniya, the patient's platelet count drops drastically. The leaves of the papaya tree are used to increase these counts and its roots as lithenotropic for the removal of kidney stones. In such cases, investigation of parts other than the fruits or seeds of diocious plant are needed.

Number of diocious plants in comparison to monocious plants are few but many amongst them are highly valued therapeutically e.g. stems of *Tinospora cordifolia,* leaves of *Cissampelos Pereira, Trichosanthus dioca, Piper betle, Celastrus paniculata, Ginko biloba, Putranjiva roxburghii, Mallotous philippensis* etc., roots and stems of *Coscium fenestratum*, rhizomes of *Valeriana wallichi*, bark of *Myrica nagi*, oleo-gum resin of *Commiphora wightti* etc.

Some amongst these have been investigated at the Gujarat Ayurved University, Jamnagar, India. Leaves of the female plant of *Tinospora cordifolia, Piper betle, Trichosanthus dioca, Cissampelos pareira, Cyclea peltata* were found to be superior so far as their active chemical constituents are concerned rather than the male plants. Similarly, stems of female plants of *Piper nigrum, Piper longam* were found to contain more piperine alkaloid than those of the stems and roots of the male plant.

Based on these findings, it would be incorrect to say that female parts of plants are always superior to their counterparts e.g. 'Arca' of *Pandanus odoratissimum* are always collected from the flowers of the male plants since they are rich in volatile oils. Scientific investigations are needed to prove or disprove, which of the gender is superior so far as their primary or secondary metabolites of the various parts of the diocious plants are concerned.

Thank you once again, for giving me this opportunity to share my views. I wish you all the very best.

Plenary Lecture
Value-Added Nanomaterials from Local Minerals

R.M.G. Rajapakse, Piumnil Gamagedara, M.M.G.P. Mantilaka, S.L. Wijesinghe
G.R.A. Kumara, A. Pitawala, N. Gunawardhana, S. Kohombanage

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Abstract

Value-added Nanomaterials from Local Minerals is one of many research projects being carried out in versatile areas of Nanotechnology in RMGR Research Group at the Faculty of Science, University of Peradeniya. In this research, we look into adding value to impure dolomite, impure apatite, pure quartz and Sri Lankan vein graphite. We have already developed novel technologies to separate calcium, magnesium and silica components of dolomite and prepared various crystallographic phases of precipitated calcium carbonate and their polymer composites. Their technological applications have been elucidated.

This research has resulted in 12 indexed publications, a large number of conference proceedings, 5 patent applications, one Ph.D. Degree and several M.Sc. Degrees. We have also developed several novel strategies to convert local impure apatite intro pure hydroxyapatite nanoparticles and their polymer nanocomposites. This research is also progressing satisfactorily producing 4 indexed publications, several conference proceedings, one patent application, two Ph.D. Degrees and a large number of M.Sc. Degrees.

Turing on to Sri Lankan Graphite, we have developed novel strategies to purify graphite by a simple flotation method and also developed various procedures to convert high quality Sri Lankan vein graphite to various graphene products and expanded graphite products. Graphene thus

produced have been utilized as low-cost counter electrodes in dye-sensitized solar cells. We collaborate with the Toyota Technological Institute, Japan, in this graphite/grapheme research. We have just started a three-year research project to developed novel nanotechnological procedures to produce solar grade silicon without any carbon dioxide evolution to the atmosphere. Figure 1 (a) shows some of the PCC Nanomaterials and their Nanocomposites synthesized while Figure 1 (b) depicts Magnesium-based Nanomaterials synthesized starting from dolomite

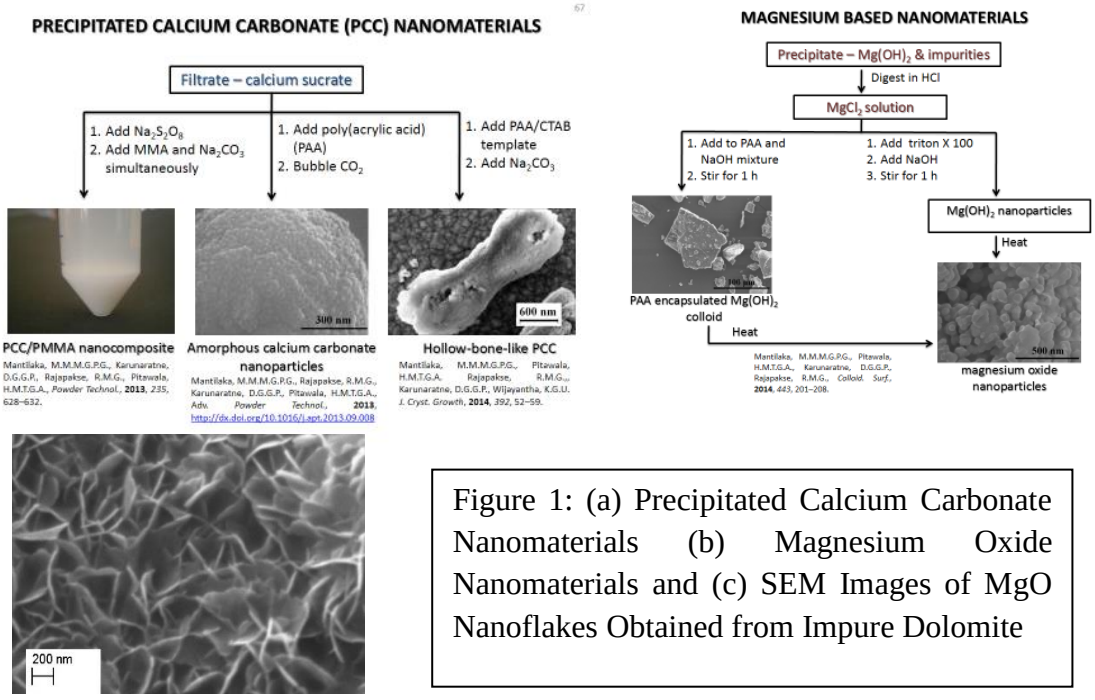

Figure 1: (a) Precipitated Calcium Carbonate Nanomaterials (b) Magnesium Oxide Nanomaterials and (c) SEM Images of MgO Nanoflakes Obtained from Impure Dolomite

Phytochemicals and Trace Elements in Selected Wild Fruits in Sri Lanka

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[2]Research Division for Food Industry Platform Technology, Korea Food Research Institute, Republic of Korea

Abstract

The objective of the present study was to investigate phytochemicals and trace elements (qualitatively and quantitatively) of selected wild fruits; *Careya arborea* (kahata), *Calophyllum calaba* (keena), *Dovyalishebecarpa* (ketabilla), *Garcinia xanthochymus* (rata goraka), *Mangifera zeylanica* (etamba), *Manilkara zapota* (sepathilla), *Passiflora foetide* (padagedi), *Psidum guineense* (ambulpera), *Syzygium samarangense (*Jambu*)* and *Syzygium zeylanicum (*marang).

Total polyphenol content (TPC), total flavonoid content (TFC) and total alkaloid content (TAC) determined by folinciocalteu method, aluminium chloride colorimetric method and dragendroff's reagent spectrophotometric methods respectively. Trace metal elements were estimated using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Qualitative assay results confirmed presence of all five types of phytochemicals (alkaloids, saponin, tannin, phenol and flavonoid) only in *Careyaarborea* and *Syzygium samarangense*. Quantitative results for TPC was ranged from 5.70 ± 0.22 to 256.63 ± 8.82 mg/g of extract, expressed as gallic acid equivalents and TFC was ranged from 0.06 ± 0.01 to 4.08 ± 0.32 mg/g of extract expressed as quercetin equivalents. The highest TPC values were recorded in *Careya arborea* (256.63 ± 8.82 mg GAE/g of extract) followed by *Mangifera zeylanica* (110.96 ± 4.46), and highest TFC was recorded in *Careya arborea* (4.08 ± 0.32 mg QE/g of extract).The alkaloid contents ranged from 1.49 ± 0.15 to 209.33 ± 4.97 mg/g of extract and significantly highest value (209.33 ± 4.97 mg/g) was recorded in *Mangifera zeylanica*. All fruits contained zinc (Zn), calcium (Ca), potassium (K), magnesium (Mg) and manganese (Mn) ranged with

values; 4.88 - 39 mg/kg, 201-10400 mg/kg, 4500 - 15700 mg/kg, 200-4070 mg/kg and 2.38-1418 mg/kg respectively. Selenium (Se) was found in *Passiflora foetide* (0.44 mg/kg), *Careyaar borea* (0.4 mg/kg *),Mangifera zeylanica (0.2* mg/kg *), Dovyalishe becarpa* (0.19 mg/kg), *Manilkara zapota* (0.12 mg/kg), *Calophyllum calaba* (0.12 mg/kg) and *Syzygium samarangense (0.*1mg/kg *)*and Strontium (Sr) found to present in all fruits whereas highest value recorded in *Careya arborea* (120 mg/kg).Toxic heavy metals such as arsenic (As), berilium (Be), gallium (Ga), thallium (Tl), uranium (U) and mercury (Hg) were not detected in any fruit samples tested (LOD=0.1 mg/kg).The study concludes that the Sri Lankan wild fruits appeared to be a good sources of phytochemicals and essential minerals to reach human health.

Development of an Antioxidant Rich Ready to Serve Drink from *Aporosa lindleyana* Baill. (Kebella)

S. Kathirgamanathar*, W.P.K.M. Abeysekera, A.M.C.U. Binduhewa, P. Ranasinghe and M.D.P.M. Peiris

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Abstract

Medicinal plants are being used from ancient times for their healing properties. Numerous epidemiological studies have shown that the plants rich in antioxidants provide protection against multiple diseases. *Aporosa lindleyana* Baill. (Tamil: Vittil; Sinhala: Kebella) is used as a leafy vegetable in Sri Lanka. Although, the root and bark were reported to have many biological activities, in our previous finding the leaves showed potential antioxidant activity. The present study focused to develop an antioxidant rich ready to serve drink (RTS) with acceptable taste and quality, using the leaves of this plant.

Fresh *A. lindleyana* leaves were collected from a home garden, cleaned, oven dried at 50 °C for 6 h and powdered. The crude ethanolic extract was prepared with 95% ethanol (leaf powder: ethanol – 1:25) by soxhlet extraction followed by evaporation of solvent. Ethanolic extract (100 mg), sucralose, citric acid, salt, permitted food preservative, flavours and emulsifiers were used to formulate the drink (200 mL). Drink was homogenized, pasteurized and hot filled. RTS drink (100 mg of ethanolic extract/200 mL) was evaluated for antioxidants [Total Polyphenolic Content (TPC) and Total Flavonoid Content (TFC)] and antioxidant activities [Ferric Reducing Antioxidant Power (FRAP), DPPH and ABTS], *in vitro* (TPC, TFC, FRAP, DPPH, ABTS and ORAC: n=4 each), microbiological quality (SLS 729: 2010), total soluble solids (TSS), titratable acidity (SLS 729: 2010), pH and organoleptic properties (appearance, colour, odour and flavour) by acceptance test (SLS 729: 2010).

RTS drink possess antioxidants TPC and TFC (0.096±0.001 mg gallic acid equivalents/mL of drink and 0.013±0.008 mg quercetin equivalents/mL of drink) while the antioxidant activities of FRAP, DPPH, ABTS and ORAC was 9.40±1.37, 103.95±5.12, 141.34±3.99 and 144.85±3.21 mg trolox equivalents/mL of drink, respectively. RTS drink complied with microbiological requirements, TSS (0.2±0.00º Brix), titratable acidity (0.24±0.01% anhydrous citric acid w/v). The product had acceptable organoleptic properties.

In conclusion, RTS drink with marked antioxidant properties and good sensory profile could be developed using leaves of *A. lindleyana*.

Investigation of Bio-activities of Extracts of *Dillenia retusa* for Drug Leads

H.D.S.M. Perera*[1], J.K.R.R. Samarasekera[1], S. Handunnetti[2], O.V.D.S.J.Weerasena[2], A. Jabeen[3] and M.I. Choudhary[3, 4]

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Abstract

Genus *Dillenia* comprises of several species of which, a range of pharmacologically important bio-activities are reported. *Dillenia retusa* (Godapara) is an endemic Sri Lankan medicinal plant, with a known therapeutic potential in traditional system of medicine and yet to be scientifically investigated for its unrevealed bio-active potential. The present study aims at investigating anti-oxidant, anti-inflammatory and anti-microbial activities of bark, fruit and leaf extracts of *D. retusa* in order to isolate bio-active compounds and formulate herbal products.

The fruit, bark and leaves were extracted with ethanol using cold extraction technique to obtain ethanol bark extract (EBE), ethanol leaf extract (ELE) and ethanol fruit extract (EFE). The extracts were tested for anti-oxidant, anti-inflammatory, antimicrobial (using micro-plate based alamar blue anti-bacterial assay against *Shegela flexneri*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus* and MDR species of *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella enterica*, and MRSA, β-lactamase enzyme inhibitory assay) and anti-fungal (using agar tube dilution method *Candida albicans*, *Candida glabarata*, *Microsporum canis*, *Trichophyton rubrum*, *Aspergillus niger*) activities.

The ELE showed promising anti-oxidant activities with high DPPH free radical scavenging (IC_{50}: 7.32 ± 0.21 μg/mL), ferric reducing anti-oxidant power (1049.70 ± 0.29 mg trolox equivalent (TE)/g of extract), oxygen radical absorbance capacity (1447.62 ±7.78 mg TE/g of extract) together with high total polyphenolic (394.15 ± 1.31 mg Gallic acid equivalent (GAE)/g) and total flavonoid contents (16.77±0.38 mg Quercetin equivalent (QE)/g) in comparison to that of bark and fruit extract. The highest anti-inflammatory activity was observed for the leaf extract with marked oxidative burst inhibitory (WB- IC_{50}: 30.04 ± 1.33 μg/mL, PMN- IC_{50}: 0.14 ± 0.03 μg/mL), good anti-A5-LOX (IC_{50}: 23.01±0.59 μg/mL), anti-xanthine oxidase (76.71±1.91%; 250 μg/mL) and anti-hyaluronidase (72.74 ± 0.88 %; 500 μg/mL) activities in comparison to bark extract and fruit extract.

In anti-bacterial assays, the extracts showed moderate to low activities (< 50 %) at tested concentrations (0.15 – 2.4 mg/mL) against the tested bacterial strains except for *S. flexneri* and *P. aeruginosa* (> 50%) and ELE showed the highest β-lactamase enzyme inhibitory activity (IC_{50}: 226.25±10.53 μg/mL). In anti-fungal assay, ELE showed moderate activities against *C. albicans* (33.67 ± 0.51%; 2.4 mg/mL) and *A. niger* (37.33 ± 1.02%; 2.4 mg/mL) whereas no activities observed for other tested species at tested concentrations. All bio-activities were significant at $p< 0.05$.

To our knowledge, this is the first report on these bio-activities for *D. retusa*. ELE is selected as a good source of anti-inflammatory and anti-oxidant agents, which deserves isolation and characterization of bio-active compounds. The anti-inflammatory and anti-oxidant activities of EFE may support the traditional use of fruit of *D. retusa* as a hair tonic, indicating its suitability in hair care formulations.

Acknowledgement: National Research Council Grant No. NRC-12-100 for financial support

In vitro Tyrosinase, Elastase, Hyaluronidase Inhibitory and Antioxidant Activities of *Artocarpus altilis (Artocarpus incisus)*

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Abstract

Reactive oxygen species (ROS) and free transition metal ions cause oxidative damage to various bio-molecules resulting aging and skin pigmentation. Plant extracts are rich in enzyme inhibitors that can protect the skin by scavenging ROS, absorbing UV light and suppressing physiologically important enzymes such as elastase, hyaluronidase and tyrosinase. *Artocarpus altilis* (Moracea) has been used in traditional folk medicine against liver cirrhosis and hypertension. This study is aimed at determining elastase, tyrosinase and hyaluronidase inhibitory and antioxidant activities of ethanol extract of *A. altilis* grown in Sri Lanka.

Ethanol extracts of air-dried and powdered bark, leaves, and fruits of *A. altilis* were evaluated *in vitro* for tyrosinase, hyaluronidase and elastase inhibitory activities and the antioxidant activity by DPPH (1, 1-diphenyl-2-picrylhydrazyl) free radical scavenging, ferric ion reducing antioxidant power (FRAP) activity, oxygen radical absorbance capacity (ORAC) assays, and–total phenolic content (TPC), total flavonoid content (TFC) by following standard protocols.

Ethanol extract of *A. altilis* bark showed good tyrosinase inhibitory activity having IC_{50} value of 27.47±0.45 µg/mL in comparison to that of leaf (52.43% at 100 µg/mL) fruit (IC_{50} 173.9±3.9 µg/mL), and positive control Kojic acid (IC_{50} 76.6±0.8 µg/mL). Ethanol extract of *A. altilis* leaf and fruit did not show elastase inhibitory activity and bark exhibited poor elastase inhibitory activity (23.83% at 500 µg/mL). *A. altilis* bark exhibited good (68.59% at 500 µg/mL) hyaluronidase inhibitory activity compared to the positive control tannic acid (90.3% at 500 µg/mL). Ethanolic extract of leaves of *A. altilis* exhibited highest DPPH free

radical scavenging activity having IC_{50} value of 30.72±0.85 µg/mL compared to those of bark (476.3±8.7 µg/mL) and fruit (1348±77 µg/mL). However, this was lower than the positive control trolox (5.3±0.1 µg/mL). *A. altilis* leaf extract showed highest ORAC value of 673.4±33.5 mg TE/g compared to those of bark and fruit. Ethanol extract of *A. altilis* leaves and fruit showed a good FRAP value (234.8±1.6, 254.8±2.9 mg TE/g of extract) compared to those of bark. *A. altilis* showed good TPC values 15.66±1.26, 10.11±0.29, 14.18±2.63 mg GAE/g for bark, leaf and fruit respectively, which are not significantly different ($P<0.05$). *A. altilis* fruits exhibited highest TFC value (4.71±0.05 mg QE/g extract) compared to bark and leaf. It is evident that ethanolic extracts of *A. altilis* bark, leaf and fruit are rich sources of tyrosinase inhibitors and antioxidants and bark is a good source of hyaluronidase inhibitors. This study supports the use of *A. altilis* extracts as active agents in cosmeceuticals, which might be used for skin whitening and anti-wrinkle preparations, to treat various skin disorders such as hyper-pigmentation.

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Utilization of Coconut Sludge Oil for Manufacturing of Quality Toilet Soap

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Abstract

Soap is an oldest known surfactant used in daily life which is technically sodium salt of fatty acids and coconut oil is used in amalgamation with other fixed oils such as palm oil, palm kernel oil etc. High price of coconut oil has reduced its utilization and also blending with animal fats leads to rejection of toilet soap by certain consumers. The present research aims to use underutilized coconut sludge oil for the manufacturing of quality assured toilet soap. Commercially available coconut sludge oils were collected from three major coconut oil manufacturing industries of Sri Lanka and subjected for physical refining at the Pharmacognosy lab of HTS. Three different soap samples were prepared using refined sludge oil as base oil and subjected for testing as per SLS 34:2009. The results showed that the soap samples contained total fatty matter of 73.19 ± 3.09, 81.13 ± 8.9, 83.37 ± 3.54 and chloride concentration of 0.41 ± 0.09, 0.26 ± 0.2, 0.28 ± 0.03. Total free alkali contents of the samples were 0.07 ± 0.00, 0.21 ± 0.16, 0.26 ± 0.01. Free Caustic alkali 0.05, 0.08, 0.03 while insoluble matter 3.08, 1.56, 3.55 for the three soap samples respectively. Results of this preliminary study revealed that two of the soap samples were within the range of the standard values of total fatty acids and there is a potential to use the coconut sludge oil in place of expensive coconut oil. Hence, the findings will help industries to produce cost effective toilet soap and also to add value to underutilized coconut sludge oil. However, further research is needed to confirm the findings.

Acknowledgement: TG 16/119 Value addition to coconut oil

Antioxidants and Antioxidant Activity of Different Maturity Stages of Leaf of Ceylon Cinnamon (*Cinnamomum zeylanicum* Blume) *In vitro*

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Abstract

Oxidative stress is closely related and tightly linked with the pathophysiological processes of numerous degenerative diseases such as diabetes, cardiovascular disorders, cancer, inflammation and aging. Combat of oxidative stress through natural antioxidants is increasing considerably throughout the world during last few decades due to less or no side effects. We have previously reported leaf of Ceylon cinnamon (CC) as a rich source of natural antioxidants and possess antioxidant activity through multiple mechanisms. However, to date variation of antioxidants and antioxidant activity at different maturity stages of leaf of CC is not reported. The present study therefore evaluates the antioxidants and antioxidant activity of different maturity stages of leaf of CC *in vitro*.

Freeze dried dichloromethane: methanol (1:1, v/v) extracts of different maturity stages (immature, partly mature and mature) of leaves of CC were used in the study. Antioxidants [total polyphenolic content (TPC) and total flavonoid content (TFC)] and antioxidant activity [1, 1-diphenyl-2-picryl-hydrazyl (DPPH), 2-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) and oxygen radical absorbance capacity (ORAC) and ferric reducing antioxidant power (FRAP)] were evaluated using 96-well micro plates based antioxidant bio assay protocols *in vitro* (TPC, TFC, DPPH, ABTS and ORAC n=4 each; FRAP n=3 each).

Results clearly revealed significant differences ($p < 0.05$) among different maturity stages of leaf of CC for both antioxidants and antioxidant activity. The mean antioxidants and antioxidant activity of immature, partly mature and mature leaves ranged from TPC: 0.68 ± 0.02 – 22.35 ± 0.21 mg gallic acid equivalents/g of sample (GS); TFC: 0.85 ± 0.01 – 4.68 ± 0.06 mg quercetin equivalents/GS; DPPH:

0.42 ± 0.01 – 27.09 ± 0.65 mg Trolox equivalents (TE)/GS; ABTS: 3.57 ± 0.10 – 43.91 ± 1.46 TE/GS; ORAC: 0.71 ± 0.01 – 18.70 ± 0.26 TE/G and FRAP: 0.31 ± 0.02 – 69.16 ± 0.52 TE/GS. Mature leaf had the highest antioxidants and antioxidant activity for all the assays investigated. In contrast, immature leaf had the lowest antioxidants and antioxidant activity. The order of potency for antioxidants and antioxidant activity was mature leaf > partly mature leaf > immature leaf.

It is concluded that all the maturity stages of leaf of CC studied had antioxidants and antioxidant activity with varying degrees of potential. However, mature leaf showed the highest antioxidants and antioxidant activity. This is the first study to report antioxidants and antioxidant activity of different maturity stages of leaf of Ceylon cinnamon and highlights its potential use in management of oxidative stress-associated chronic diseases.

Analysis of Volatile Constituents of Leaf, Stem Bark and Root Bark Oils of *Cinnamomum capparu-coronde* Bl.

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Abstract

The chemical composition of the essential oils of leaf, stem bark and root bark of Kapuru kurundu (*Cinnamomum capparu-coronde* Bl.) collected from Sinharaja Forest Reserve was studied by Gas Chromatography (GC) and Gas Chromatographic- Mass Spectrometry (GC-MS) for the first time in Sri Lanka. The oil contents were 1.67% (v/w) in leaf, 0.75% (v/w) in stem bark and 1.60% (v/w) in root bark. The oil of stem bark has linalool (44.5%), d-limonene (9.3%), eugenol (7.1%) and 1,8-cineole (6.3%) as the major compounds among 62 compounds. Thirty three components were identified in the leaf essential oil and the main components were eugenol (71.6%) and linalool (8.8%). However, root bark oil contains totally different type of major components [safrole (58.6%) and d-camphor (16.4%)] compared to leaf and stem bark oils. Previous Gas Chromatographic studies on the steam distilled bark oil of Kapuru kurundu showed that the bark oil contains linalool (29%), eugenol (23%) and 1: 8 cineole (16%) as major constituents. Further, Thin Layer Chromatographic (TLC) analysis of essential oils showed that *Cinnamomum capparu-coronde* Bl. bark contains eugenol in high amount and linalool in moderate amount; leaf oil has eugenol as the major compound, whereas, root bark contains cinnamldehyde as the major compound. The present detailed study on GC & GC-MS, confirms the previously published major chemical components of essential oils of stem bark and leaf of *Cinnamomum capparu-coronde* Bl. However, the previous TLC results of root bark oil does not match with the GC results of present study. In conclusion, the stem bark oil or constituents stem bark oil of *Cinnamomum capparu-coronde* Bl. has high potential to incorporate for perfumery formulations in future.

In-silico study of Binding Interaction of Renin with Phoenicanthusine

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Abstract

The search for novel drug leads has improved from trial and error into sophisticated methods that include many computer-based approaches. *In silico* models provide high throughput analysis and are used in the early stages of the drug development process. Thus *in-silico* approach allows for a faster and cheaper identification of promising drug candidates by virtual screening of compound databases.

Inhibitors of Renin are a primary line of therapy for myocardial infarction, heart failure, hypertension and diabetic nephropathy. Thus, a good hit through molecular studies could result in a better drug. Angiotensinogen is the only known naturally occurring substrate for renin and inhibition of this reaction could have many advantages.

In this study, Sri Lankan natural product database was virtually screened against Renin. Potent hits were put through refined docking using different algorithms and advanced scoring functions were used to filter the results. Molecular Dynamics simulations were then performed for best candidates, followed by calculation of free energy of binding.

Phoenicanthusine displayed favourable results when it was docked against Renin, and Aliskiren was used as the reference compound since it is the most common drug available in the market now. Pheonicanthusine and Aliskiren both displayed possible covalent bonds with Asp 32 in the active site of renin. Howevr, Aliskiren was stabilized due to possible pi-alkyl and alkyl interactions with Tyr 75, Val 120, Phe 112, Ala 300, Ile 291 and Met 289, whereas, phoenicanthusine had possible pi-sulfur and pi-anion interactions in addition to the pi-alkyl interactions.

Moreover, Phoenicanthusine showed possible pi-anion interactions with Asp 215. Interaction with both Asp 32 and Asp 215 is important for the inhibition of renin.

Therefore, Phoenicanthusine is a good candidate for further studies of inhibition of renin.

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In-silico study of Acetylcholinesterase Inhibitors from Xanthone Derivatives from Natural Products found in Sri Lanka

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Abstract

Acetylcholinesterase (AChE) converts Acetylcholine(ACh) to choline and acetic acid. Cholinesterase is inhibited by AChE inhibitors which prevents breakdown of ACh. Therefore, AChE inhibitors may be used for the treatment of neurodegenerative conditions such as Alzheimer's disease (AD), Lewy Body Dementia and Parkinson's disease. In this study, 486 Natural products from over 200 Sri Lankan plant species published were virtually screened, and binding of Xanthones to AChE was investigated.

Geometry optimization of best conformer and calculation of HOMO/LUMO energies were performed. Molecular Dynamics were carried out using Amber to equilibrate the X-ray structure prior to docking and to predict and compare the stability of the docked complexes. Docking was carried out for Xanthones using AutoDock Vina, AutoDock 4 and iGEMDOCK. They had comparable binding affinities to the (+)ve control, Rivastigmine which is the most commonly used commercial drug in all docking methods used.

All docked molecules are located in the active site gorge of AChE so as to maximize the favourable contacts. Hydrogen bonds and vander Waals forces are the main features of these interactions with TRP84, TYR121, SER200, PHE330, TYR334 and HIS440 of AChE. π-π interactions contribute to ligand-AChE stability and selectivity. These are formed between aromatic rings of ligands and the aromatic ring from the TRP84, HIS440 and PHE331 of AChE. All compounds make direct contact with TRP84 and HIS440 of AChE.

The results suggest the importance of electronic effects on ligand recognition, as compounds with highest affinity to AChE have high LUMO energy and low

HOMO energy. These compounds are active site directed for AChE. They bind predominantly with the Trp84 of AChE, and probably decreases enzyme activity 3000-fold. π-π interactions with HIS440 give ligand-AChE complexes high stability. The insights gained from the study have revealed great potential for design of novel drugs.

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Gastroprotection and Toxicity of Ethyl Acetate Fraction of *Trichosanthes cucumerina*. Linn in Rats

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Abstract

Antacids, anticholinergic drugs, histamine H2- receptor antagonists and irreversible proton pump inhibitors have been used for the treatment of gastric ulcers. However, prolonged use of these drugs may lead to series of adverse effects such as diarrhea, headache, rash, hypertension, muscular and joint pain. Therefore, there is an urgent need of more effective and safer treatments with fewer side effects. The aim of the present study was to scientifically evaluate the gastroprotective activity of fractions of the hot water extract of *Trichosanthes cucumerina* Linn (Family: Cucurbitaceae) aerial parts with a view to identifying the fraction with the best gastroprotective activity and the possible toxicity effects in rats. Gastroprotective activity of hexane fraction (HF), ethyl acetate fraction (EF), butanol fraction (BF) and aqueous fraction (AF) were evaluated by the assessment of ability to reduce the ulcer index in ethanol-induced rat model. For the toxicity, rats were randomly divided into 2 groups. Rats in group 1 (control) and group 2 (test) received 1 ml of distilled water/day and EF (75 mg/kg/day) for 42 consecutive days. Rats were checked twice daily for overt signs of toxicity and average food and water intake was determined weekly for each group. The consistency of faeces and color of the urine were noted daily. Liver functions and renal toxicity were evaluated by serum analysis. Histopathology of main organs of the rats was examined for detection of any toxicity. EF showed the maximum

gastroprotection effect followed by BF and AF. EF (75 mg/kg) exhibited significantly higher gastroprotection compared to the reference drugs. Further investigations with two lower doses of EF confirmed that EF can mediate a significant and dose dependent gastroprotection. No toxic effects were observed for EF treated group in terms of any deaths, overt signs of toxicity, hematological parameters, liver and kidney toxicity. In conclusion, EF at a dose of 75 mg/kg exhibited marked gastroprotection and did not produce any serious toxicity in rats.

Physico-chemical Properties of Virgin Coconut Oil and King Coconut Oil

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Abstract

Coconut oil is one of the most widely used products made from coconut which is utilized for various industrial purposes. In addition there are different types of coconut oil used in industry such as virgin coconut oil obtained by fermentation process and king coconut oil obtained by expeller pressed method. The main difference between these oils is in the way they are being processed. Virgin coconut oil obtained by fermentation process and king coconut oil obtained by expeller pressed method are not studied for their physico-chemical properties and therefore, such properties have been established by referring to SLS 32: 2002. Three samples from virgin coconut oil and king coconut oil were collected from commercially available samples and composited and then subjected for analysis as per SLS 32:2002, specification for coconut oil. Moisture & other volatile matter (at 105 ±2 ^{0}C), Relative Density at 30 ^{o}C ,Refractive index at 40 ^{o}C ,Free Fatty acid as lauric acid % by mass, Iodine value, Saponification value, Unsaponifiable matter, % by mass, Insoluble impurities, % by mass and Peroxide Value of virgin coconut oil are 0.61 ± 0.04, 0.918 ± 0.04, 1.4485 ± 0.03, 0.18 ± 0.08, 7.47 ± 0.03, 255.73 ± 0.11, 0.15 ± 0.04, 0.04 ± 0.04 and 0.97 ± 0.02 respectively. Moisture & other volatile matter (at 105 ±2 ^{0}C), Relative Density at 30 ^{o}C ,Refractive index at 40 ^{o}C ,Free Fatty acid as lauric acid % by mass, Iodine value, Saponification value, Unsaponifiable matter, % by mass, Insoluble impurities, % by mass and Peroxide Value of king coconut oil are 0.35 ± 0.03, 0.914 ± 0.00, 1.4468 ± 0.00, 0.18 ± 0.04, 8.45 ± 0.16, 253.77 ± 0.47, 0.19 ± 0.01, 0.04 ± 0.00 and 0.9 ± 0.02 respectively. From the results it was observed 0.61 ± 0.04 moisture in virgin coconut oil obtained by fermentation process compared to 0.5 maximum in the

standard that might affect the oil quality and needed to fortify with suitable preservative to enhance the shelf life. Other parameters are within the range of SLS 32. By using above data and continuing further studies on more samples recommendation can be made to SLSI for future revisions and inclusions to SLS 32 that will cater the industries to get their raw materials tested accordingly.

Acknowledgement: TG 16/119 Value addition to coconut oil

Entomocidal Activity of Native Strains of *Bacillus thuringiensis kurstaki* against Rice Pest *Cnaphalocrocis medinalis*

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Abstract

Cnaphalocrocis medinalis or rice leaf folder (Lepidoptera) is an important pest damaging the rice crop in the country. Recommended chemical pesticides, such as tebufenozide, imidacloprid, fipronil are currently in use for the management of this pest. *Bacillus thuringiensis* (*Bt*) is a spore forming, entomopathogenic, gram positive bacterium that produces, insecticidal δ – endotoxins that are active against different insect orders including; Lepidopterans, Coleopterans and Dipterans. *Bt* based bio-pesticides are commonly used across the world to control insect pests as an alternative to synthetic pesticides. The objective of this study was to evaluate the insecticidal activity of four native strains of *Bt kurstaki* (*Btk*) against *C. medinalis* under laboratory conditions. Previously isolated *Bt kurstaki* (AB1, AB8, AB15 and AB49) strains, which were deposited at the ITI culture collection were used in this study. *Btk* was cultured in a molasses-based medium in a fermentor using optimal culture conditions (pH=7, agitation 300 rpm, Temperature 30 ˚C) for 30 h. Resultant pellets were freeze-dried to obtain *Bt* primary powder. Colony Forming Units (CFU) of *Btk* were calculated for the obtained primary powder. Second instar larvae of *C. medinalis* were collected from fields at Rice Research and Development Institute, Bathalagoda. Leaf dip bioassay was performed to evaluate the insecticidal activity of *Btk* strains against *C. medinalis* larvae. Fresh paddy leaves were given as food for the larvae daily. Larval mortality was recorded every 24 h until 100% mortality or pupation was observed. Lethal concentration (LC_{50}) was calculated using probit analysis for the data collected

after 72h of exposure. Results indicated that percentage mortality of *C. medinalis* increased with the time and spore concentration. *Btk* AB1, *Btk* AB8, *Btk* AB15 and *Btk* AB49 showed insecticidal activities against *C. medinalis* with LC_{50} of 3.34 x 10^8 spores/mL, 6.24 x 10^4 spores/mL, 1.96 x 10^6 spores/mL and 1.83 x 10^5 spores/mL, respectively. Out of the above mentioned, *Btk* AB8 showed the highest insecticidal activity against *C. medinalis*. It was concluded that these native strains of *Btk* could be used as an effective bio-control agent against the rice pest *C. medinalis*.

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Anti-inflammatory Activity of *Curcuma albiflora* on Cotton Pellet-induced Granuloma in Rats

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Abstract

Harankaha is an important medicinal plant used in Sri Lankan Traditional Medicine. Due to similar morphological characters and same *Sinhalese* vernacular name of *Curcuma* species, adulteration or substitution takes place (*C. albiflora*, *C. zedoaria*, and *C. aromatic*). Current study was conducted to understand the anti-inflammatory activity of *C. albiflora* cotton pellet-induced granuloma (sub-acute anti-inflammatory model) in rats. Anti-inflammatory activity of *C. albiflora* has not been studied. Plants were collected in March, 2017 from Kegalle and Ratnapura districts. Voucher specimens of the plants were authenticated from National Herbarium, Peradeniya, Sri Lanka. Whole plant extract was prepared using ethanol and water (1:1) v/v as the solvent mixture by continuous extraction (6 h). Required concentrations (200 mg/kg, 400 mg/kg, and 600 mg/kg) were prepared using distilled water as the solvent. The animal dose was calculated based on human equivalent dose. Wistar female rats (n=5) from MRI, Colombo weighing 160 - 250 g, 12-15 weeks old were used. The study protocol and procedures were reviewed and approved by FGS, Colombo ethics committee and conducted in accordance to the WHO guidelines. They were fed commercial pellet diet and water ad libitum. Granulomatous lesions were induced by surgically implanting two cotton pellets subcutaneously in the dorsal region of the rats near the axila. *C. albiflora* extract was administered orally before 1 h of the surgery. Rats were anaesthetized using ketamin (0.6 ml/kg) and autoclaved sterile pellets of cotton (8 ± 0.5 mg each) were implanted. The rats of the control group were administered with water and standard group by Indomethacine (5 mg/kg). Drugs and water was administered for 7 consecutive days. Rats were anaesthetized on the eighth day

using ketamin and the pellets were dissected out carefully and dried at 60°C (3 d). Mean weight of the granuloma tissue formed around each dried pellets were recorded. The data were statistically evaluated with Minitab 17 software. The results were expressed as the mean ± SEM. Inhibition percentages were found as 53.3 % (Standard), 11.1 % (200 mg/kg treated group), 21.7 % (400 mg/kg treated group), and 18.6 % (600 mg/kg treated group). From the present study, it can be concluded that there was a moderate anti-inflammatory activity for the mid dose (400 mg/kg) of the extract. In addition, more acute and chronic anti-inflammatory models are needed to validate the anti-inflammatory activity of *C. albiflora.*

Expression of Rabies Virus Specific Glycoprotein as a Recombinant Protein in Bacterial Expression System for the Development of a Diagnostic kit

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Abstract

Rabies is a viral infection spread via saliva of infected animals by biting another animal or a person. Rabies virus affects the central nervous system, particularly causing inflammation in the brain. Domestic dogs, cats, rabbits as well as wild animals are responsible for spreading the disease. Currently, many tests and assays have been approved by the WHO to detect the levels of rabies. In these tests neutralized antibodies are used in order to determine if people have been successfully immunized against the disease. However, these tests are expensive. Hence, it is vital to develop and standardize a simple technique such as Enzyme Linked Immunosorbent Assay (ELISA) to determine the level of antibodies against rabies virus. The aim of the present study was to transform recombinant vector containing rabies virus specific glycoprotein gene (RVG) into bacterial expression system and optimize the expression conditions for higher production of recombinant protein. Previously cloned RVG containing recombinant vector pET28a(+)-RVG and vector DNA (pET28a(+)) were successfully transformed into *E. coli* BL21 electro-competant cells. Colonies were screen by colony PCR and expected size (1591 bp) was observed in recombinant clones containing RVG gene. SDS-PAGE analyses of cell lysates derived from positive clones revealed an extra band having expected size of 58 kDa in recombinant clone pET45b(+)-RVG following induction with IPTG compared to non-induction samples and vector controls. Further studies should be needed to confirm the expression of RVG protein.

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Optimization of a Low Cost Medium for the Production of Alpha Amylase using *Bacillus licheniformis*

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Abstract

Enzymes are best suited for harsh industrial processes. Alpha amylase is a hydrolyse type enzyme, which aids in the breakdown of starch into maltose. Thermostable alpha-amylases have many commercial applications in starch processing, brewing, sugar production and detergent manufacturing industries. The aim of this research is to optimize the growth conditions and growth medium for the production of thermostable alpha-amylase. *Bacillus licheniformis (*ATCC 14580) was the bacteria used in this study. Enzyme activity was measured in different temperatures (37 ^{o}C and 48 ^{o}C) and spectrophotometric readings were taken after 24, 48 and 72 hours using 3,5–Dinitro salicylic acid as a substrate. Highest enzyme production was shown at 37 ^{o}C after 24 hours of incubation. Medium was prepared with 1% dried powder of variety of carbon sources such as cassava, corn, rice bran and sweet potatoes. NaCl, $CaCl_2$, $MgSO_4$ and NH_4Cl were used as an inorganic ions and soy powder was used as the organic nitrogen source. The pH of the medium was adjusted to 7.0. According to the results, we conclude that 1% cassava with 1 g dm^{-3} of NaCl, 0.2 g dm^{-3} of $CaCl_2$, 0.5 g dm^{-3} $MgSO_4$, 1 g dm^{-3} of NH_4Cl and 1 g dm^{-3} of soy powder can used as low cost medium for the production of alpha-amylase at 37 ^{o}C after 24 hours of incubation.

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Identification and Characterization of Bacterial Strains Isolated from Glyphosate Contaminated Water in Selected Agricultural Fields

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Abstract

Usage of pesticides is increasing progressively in agricultural fields to improve food productivity. Accumulation of these pesticides may harm the environment as well as habitats in agricultural fields and the surrounding environment. However certain bacteria have the ability to degrade large molecular weight pesticides in water. The main objective of this research was to identify the bacterial strains isolated from glyphosate contaminated water from a tea plantation in Rathnapura and a vegetable farm in Dambulla district. DNA was extracted using the QIAamp DNA mini kit, concentrations were measured using flurometer and spot gel test. Purity of DNA was checked using a dual beam spectrophotometer prior to amplification using 16s rRNA primers (27F and 1492R). Amplified DNA was run through a 1% agarose gel to observe the amplified products. Since non specific bands were also amplified in PCR, genomic DNA was sent for sequencing to Macrogen, South Korea. Sequencing results revealed that *Bacillus licheniformis*, *Pseudomonas pseudoalcaligenes*, *Enterobacter cloacae*, and *Staphylococcus* sp. were present in glyphosate contaminated water. Further studies are necessary to identify the glyphosate degrading ability of these bacterial strains.

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Molecular Characterization of Bacterial and Fungal Strains Isolated from Petroleum Contaminated Sites in Sri Lanka

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Abstract

Petroleum contaminations of soil and water bodies have become a growing concern due to its high toxicity and carcinogenic properties. Bioremediation is one of the promising technologies for the treatment of these contaminated sites by the action of microbes. The objective of the present study was molecular characterization of bacterial and fungal strains isolated from petroleum contaminated sites. Ten bacterial isolates (C1, C2, C3, C4, C8, C9, C10, C11, C12 and C13) and three fungal isolates (I_5R_1, I_6R_2 and I_7R_1) were obtained from a previous study, which were collected from an area subjected to long term intermittent discharges of petroleum hydrocarbons in Western province, Sri Lanka. Partial gene sequences of 16S rRNA and 18S rRNA were used as genetic markers for the identification of bacterial and fungal strains, respectively. Genomic DNA was extracted by QIAamp DNA Mini Kit (Qiagen). Expected size bands of 1500 bp and 600 bp were observed for the bacterial and fungal strains respectively, after amplification of 16S rRNA partial gene product and 18S rRNA partial gene product, with universal primers of 1492R/27F and ITS1/ITS4. Sequencing results were matched with the species available in the GenBank database and were identified as *Bacillus licheniformis* (C1, C11, C12 and C13), *Gluconacetobacter* sp. (C2), *Comamonas testosterone* (C3), *Bacillus infantis* (C4), *Ralstonia* sp. (C8), *Ochrobactrum* sp. (C9), *Microbacterium xylanilyticum* (C10), *Penicillium citrinum* (I_5R_1), *Rhinocladiella similis* (I_6R_2) and *Penicillium citrinum* (I_7R_1). This study is important for identification of environmental friendly bacterial and fungal isolates for re-introducing into petroleum contaminated sites as bioremediation agents.

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Conventional Duplex PCR: A Reliable & Sensitive Tool for Detection of Bovine and Porcine DNA in Gelatine Containing Food and Pharmaceutical Products

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Abstract

Detection of bovine and porcine species in commercialized gelatine containing food and pharmaceutical products are required for health safety concerns and for some religious practices. Consumers have the right to know what is in their food or pharmaceutical product they are consuming. Gelatine is a highly processed protein product, commercially produced from animal skin and bones, mostly derived from pig, cattle and fish. Detection of source of gelatine is an important aspect when it comes to vegan and some religious communities.

In this study isolation of DNA was performed with DNeasy Mericon Food Kit by QIAGEN from two sources of food containing gelatine, one pharmaceutical capsule outer cover, pork beef meat (positive samples) and dried sea weed (negative sample). To confirm whether the required DNA has been extracted, a spectrophotometer and fluorometer was used. A conventional duplex polymerase chain reaction (PCR) assay was performed targeting a 289 bp porcine and 251 bp bovine region from mitochondrial DNA to simultaneously detect both porcine and bovine DNA in gelatin containing food and pharmaceutical samples. Additionally a simplex PCR assay was carried out targeting a 592 bp region from a chloroplast gene to confirm sea weed as a plant. A 2% agarose gel was used to run the PCR products.

Gelatine powder, jelly cup, capsule and dried sea weed showed positive results for the bovine DNA in three replicate PCR trials. Human DNA and the PCR negative control showed negative results indicating that the regents are not contaminated. The positive band observed in sea weed may due to unintentional machinery

contamination during the production process. Dried sea weed DNA was confirmed as a plant origin using a chloroplast gene. In this study conventional duplex PCR methodology proved to be a reliable and sensitive tool for detecting porcine and bovine DNA fragments (longer than 100 bp) present in gelatin containing food and pharmaceutical products. The proposed methodology is an easy-to-follow, inexpensive, reliable method used for monitoring food and pharmaceutical products.

Evaluation of Methods for the Extraction of Genomic DNA from Processed Dairy Foods

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Abstract

Processed dairy food products are very significant to human health due to its high nutritional value. Therefore in recent years several reliable molecular based methods have been developed and proposed for processed dairy food product analysis. Isolation of amplifiable genomic DNA from different types of processed dairy foods is a crucial and necessary step for the Polymerase Chain Reaction (PCR) analysis. This study evaluated several methods to identify the most efficient method for the extraction of genomic DNA from selected processed dairy foods to carry out PCR amplification using cattle specific primers. Three different methods were optimized, evaluated and compared for their ability to isolate good quality DNA when applied to processed dairy food products. Fresh milk, Yogurt, Cheese, Buffalo Curd and Milk powder were randomly collected from the local market and the DNA was extracted using Wizard® Genomic DNA purification kit, Doyle and Doyle's modified CTAB protocol and Nemeth's modified CTAB protocol. DNA purity and concentrations were recorded using a spectrophotometer. PCR detection of extracted genomic DNA from food samples were carried out with cattle specific primers. PCR products were evaluated on 1% agarose gel electrophoresis. The results revealed the highest DNA purity (Semi-skimmed Milk-1.5214, buffalo curd-1.5712) and the highest DNA yield (Semi-skimmed Milk- 36.180 ng/µl, buffalo curd- 38.912 ng/µl) was obtained by DNA extraction with Nemeth's modified CTAB protocol with one hour incubation when compared with the other two protocols. The PCR amplification of cattle specific gene was performed in

order to confirm the quality of the DNA extracted using each method was suitable for downstream biological processes.

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Optimization of PCR Amplification of Chloroplast Gene Regions of Selected Endemic Plants for Plant DNA Barcoding and Conservation

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Abstract

Sri Lanka is an island with a tropical climate and a biodiversity hotspot in the world with around 2180 of endemic plants distinctive to the country. Sri Lanka has been prone to bio piracy throughout the years due to lack of knowledge and laws. Plants can be identified at the species level by utilizing DNA barcoding method. Thus, it can also be used as a plant authentication method for prevention of biopiracy. In this study Polymerase Chain Reaction (PCR) amplification of *rbcL* and *mat K* genes of three endemic plants of Sri Lanka namely *Vernonia zeylanica (*Pupula), *Litsea longifolia (*Rath keliya), *Holarrhea mitis (*Kiri walla) *Horsefieldia iryagedhi* (Ruk), *Machilus macrantha* (Ululu) and *Pandanus ceylanicus* (O keiya)) were collected from Royal Botanical Garden, Sri Lanka. Known chloroplast plastid DNA barcoding regions, *rbcL* and *mat K* genes were subjected to polymerase chain reaction (PCR) amplification. Plant DNA was extracted from leaves using Cetyltrimethylammonium bromide (CTAB) method and a commercially available kit. PCR amplification of *rbcL* gene was carried out under following conditions: Initial denaturation at 94 ^{o}C for 5 min followed by 35 cycles of denaturation at 94 ^{o}C for 30 sec, Annealing at 62 ^{o}C for 30 sec and extension at 72 ^{o}C for 1 min. The final extension was carried for 8 min. at 72 ^{o}C. PCR amplification of mat K gene was carried out under the following conditions: Initial denaturation: 94 ^{o}C for 1 min followed by 30 cycles of denaturation at 94 ^{o}C for 1 min., Annealing at 49 ^{o}C for 30 sec. and extension at 72 ^{o}C for 1 min. The final extension was carried for 8 mins at 72 ^{o}C. The PCR products were analyzed

on 1 % Agarose Gel Electrophoresis (AGE). For all plants, amplicons of 600 bp and 900 bp were obtained for *rbcL* and *mat K* gene regions, respectively. A band of 600 bp was observed for *rbcL* gene and a band of 900 bp for *mat K*. The PCR products have been sent for sequencing with a view of depositing the sequences in the nucleic acid data bases such as National Center for Biotechnology Information (NCBI).

Physico-chemical, Nutritional and Antioxidant Properties of Selected Black and Red Whole Long Grain Rice Varieties Developed and Commercialized in Sri Lanka

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Abstract

Long grain red pericarp basmati type rice variety and a black long grain rice variety developed and commercialized in Sri Lanka were used in the study. Moisture, crude protein (CP), crude fat (CF), crude ash (CA), total dietary fiber (TDF), total carbohydrate (TC), total available carbohydrate (TAC) and amylose content were quantified using standard analytical techniques (n=3). Antioxidant properties were investigated using total polyphenolic content (TPC), ferric reducing antioxidant power (FRAP), 2,2-diphenyl-2-picrylhydrazine (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) radical scavenging activity and oxygen radical absorbance capacity (ORAC) *in vitro*. Seventy % ethanolic extracts of the whole grain rice flour were used in antioxidant bioassays and all samples were analyzed in triplicate.

Results showed significant differences ($P < 0.05$) in the physicochemical, nutritional and antioxidant properties between black and red rice varieties. Red rice exhibited significantly high ($P < 0.05$) CP (10.76 ± 0.08%), amylose (27.00 ± 0.00%), TAC (81.88 ± 0.21%) and TC (85.09 ± 0.10%) contents while black rice showed a higher CF (3.63 ± 0.03%). Antioxidant properties of black rice exhibited significantly high ($P < 0.05$) FRAP (38.58±0.73 mg Trolox/g extract) and ORAC (107.58 ± 2.65 mg Trolox/g extract) whereas red rice demonstrated significantly high ($P < 0.05$) DPPH radical scavenging activity (120.23±.80 mg Trolox/g extract). ABTS radical scavenging activity (red: 72.19±1.92 mg Trolox/g extract; black: 75.18±0.73 mg Trolox/g extract) and TPC (red: 26.00±2.21 mg gallic/g

extract; black: 27.67±0.89 mg gallic/g extract) were insignificant ($P > 0.05$) between the two rice varieties tested.

It is concluded that physicochemical, nutritional and antioxidant properties were different between tested red and black whole long grain rice varieties. However, both varieties showed desirable physicochemical, nutritional and antioxidant properties. Therefore, both red and black whole long grain rice varieties could be recommended for consumption to obtain good nutrition and reduce oxidative stress associated chronic diseases.

Preliminary Assessment of Yeast Diversity Originating from Raw Bovine Milk and Curd of Sri Lanka

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Abstract

Yeasts are the most important industrial microorganisms which are frequently found within the micro-flora of raw bovine milk and fermented dairy foods. In recent years, yeasts have been increasingly considered as important agents in the production of Single Cell Proteins (SCP), yeast extracts, vitamins, nutritional supplements, probiotics etc. So far, only sporadic data is available on yeasts in Sri Lanka. In this context, the present study assesses the diversity of beneficial dairy yeasts originating from Sri Lankan dairies. This aim was achieved through a step-by step screening approach focused on the technological characterization, followed by evaluation for probiotic potentials of 80 yeasts originally isolated by the authors in an earlier study. Genomic DNA was extracted and purified from the best 28 isolates using the Wizard® Genomic DNA Purification Kit. Selected regions of 18S rRNA gene were PCR amplified with universal primers [ITS1 (GTAGGTGAACCTGCGG) and ITS4 (TCCGCTTATTGATATGC)] and amplified products were subjected to DNA sequencing at Macrogen-South Korea. Resulted sequences were analyzed using online Basic Local Alignment Search Tool (BLAST). The BLAST analysis carried out with all results obtained, revealed that the most promising 28 yeast isolates belonged to genera of *Pichia*, *Candida*, *Kluyveromyces* and *Isaatchenkia* of the family: Saccharomycetaceae with an abundance of 39.3%, 35.7%, 21.4% and 3.6% respectively. Considering a threshold of > 95% similarity to the type strain, 12 different yeast species were identified. The predominant species of yeasts with technological and probiotic affinities found were *Pichia kudriavzevii* (28.6%), *Kluyveromyces marxianus*

(10.7%), *Pichia sp. AQGWD 7* (10.7%), *Candida orthopsilosis* (10.7%) and *Candida metapsilosis* (7.1%). The rest of the beneficial yeast species were identified as *Candida dubliniensis, Candida parapsilosis, Candida rugosa, Candida pararugosa, Candida versatilis* and *Issatchenkia orientalis.* Phylogeny of the 12 yeast species identified in the present study to be analyzed using maximum likelihood method. This information opens up the possibility for further evaluation of these yeasts as multifunctional starters for use in small-scale and commercial production of foods and pharmaceuticals.

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Establishment of Laboratory Scale Processing Conditions for Glucose Syrup Manufacture Using Broken Rice Grains

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Abstract

Glucose syrup, an extensively used ingredient in the food, beverage and pharmaceutical sectors is solely imported to Sri Lanka. Glucose syrups contain varying amounts of glucose, maltose and oligosaccharides depending on their Dextrose Equivalent (DE) and extent and intensity of breaking down of starches from varying cereal sources. Broken rice accounts for 10 – 20 % as a by-product of rice industries. This study was conducted to establish laboratory scale processing conditions for glucose syrup manufacture using broken rice grains.

Rice variety, At 308 was selected for this study. Rice starch was extracted by alkaline extraction technique, after soaking and wet grinding. Proximate composition of the rice starch was determined. In liquefaction, wet rice starch was mixed with water and hydrolyzed with α-amylase enzyme and saccharafied with amyloglucosidase enzyme, maintaining conditions to obtain the Dextrose Equivalent (DE) of the glucose syrup within acceptable ranges. The saccharified solution was filtered, purified with activated carbon and concentrated to reach a $^{\circ}$Brix value of 74 using a vacuum evaporation. DE was measured in predetermined time intervals in hydrolysis and saccharification steps for known enzyme concentrations in order to obtain the optimum conditions which are the major controlling factors.

Expected DE of 10 - 13 was obtained after hydrolysis at 80°C and in 30 minutes time duration, with 0.01% (w/w) α-amylase concentration. Optimum conditions of saccharification were determined at 60°C and in 90 minutes time duration, with enzyme concentration of 0.01 % (w/w). DE after saccharification and DE in the final glucose syrup were 44.15 and 40.80 respectively. DE and other

physicochemical properties were comparable with the commercial glucose syrup and complied with the standards specified in the codex alimentarious.

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Sri Lankan Unripen Banana (*Musa spp*) as a Potential Probiotic Source

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Abstract

Probiotics are "live microorganisms, which when administrated in adequate amounts confer health benefit to the host". Probiotics require a substrate (prebiotic) to grow and multiply and fruits rich in prebiotics play a major role in the development of non dairy probiotic products. Nutritional and health benefits of green banana are attributed to its rich content of indigestible compounds; resistant starch (RS) and non starch polysaccharides which make up its dietary fibre. Due to the presence of water-soluble fibres, oligosaccharides and resistant starch, banana flour is rich in prebiotics and therefore can stimulate the growth of probiotic bacteria. Nine unripe banana varieties, namely *Ambul nadee, Kandula, Seeni parakum, Ambum, Kolikuttu, Nethrappalam, Seeni, Rathkesel* and *Anamalu* as recommended by the Department of Agriculture were collected from the germplasm of the Agriculture Research Stations. Fruits were processed, fermented and probiotic potential lactic acid bacteria were isolated. The isolates were characterized based on phenotypic, biochemical and genotypic studies. Bioactive and safety criteria were also evaluated using *in vitro* and *in vivo* experiments. A total of 153 bacteria were isolated; (*Ambul nadee-25, Kandula-26, Seeni parakum-18, Ambum-27, Kolikutu--14, Nethrappalam-05, Seeni-14, Rathkesel-12* and *Anamalu-12*). Among them, 82 were selected based on phenotypic characterisation. Further narrowed down to 51 based on biochemical characterization. Of these, 38 isolates demonstrated good probiotic attributes. Eleven isolates were then selected based on bio-efficacy and *in vitro* safety attributes. The selected 11 isolates; *E. durans* B_8LAB (MF405179), *E. faecium*

B_9LAB (MF480437), *W. cibaria* B_13LAB (MF480445), *E. gallinarum* B_14LAB (MF480436), *L. plantarum* B_16LAB (MF405177), *L.curieae* B_18LAB (MF405178), *E. durans* B_22LAB (MF480435), *E. hirae* B_25LAB (MF 480429), *E.faecium* B_26LAB (MF574466), *P. acidilactici* B_27LAB (MF480433) and *E. faecium* B_29 LAB (MF480430) were deposited in the NCBI Genebank. Among 11 isolates, 04 isolates that were superior with cell adhesion and aggregation properties; *P. acidilactici* B_27LAB, *E. faecium* B_29 LAB, *L. plantarum* B_16LAB, *L. curieae* B_18LAB were subjected to *in vivo* oral toxicity studies. None of the test isolates demonstrated oral acute or sub chronic toxicity. Banana flour based model probiotic product was developed using *P. acidilactici* B_27LAB and *L. plantarum* B_16LAB as starters and the total quality evaluation of the product was conducted.

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Efficacy of Ultraviolet (UV) Radiation as a Non-thermal Technique for Inactivate Microorganisms in *Aloe vera* (*Aloe barbadensis* Miller) and Curry leaf (*Murraya koennigii)* Juice

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Abstract

The efficacy of UV-C treatment as a non-thermal technique on the reduction of microorganisms in Aloe vera and curry leaf juices were evaluated. A unit composed of juice re-circulation with a pilot scale UV sterilizer (GYC-UUVE-40 W, Guan Yu, China), an overhead tank, collecting (bottom) tank, pump and flow control was fabricated. Sugar free and sugar added Aloe vera and Curry leaf Juices were UV treated under the flow rate of 0.1 m3/h at 30 ±2^{o}C and re-circulated for 9 times (UV doses range from 9.53 Jcm^{-2} to 19.06, 28.59, 38.12, 47.65, 57.18, 66.71, 76.24, 85.77 Jcm^{-2}). Samples from each re-circulation (UV processed) and pasteurized (SLS 729- 2010) samples were tested for microbiological (APC, YM), physicochemical analysis (pH, Brix, total acidity, colour, oxidative redox potential), proximate composition (total carbohydrate, crude protein, crude fat, total ash, vitamin C), and antioxidant capacity (active hydrogen**, t**otal phenolic content, **f**erric reducing antioxidant power). The statistical analysis was carried out using ANOVA to test the significance of each variable (α=0.05) and followed by comparisons performed using the Turkey test by the statistical software MINITAB ®17. One way ANOVA was used to determine the effect of treatments, and UV doses in UV treatments on different juice parameters for each juice type. Microorganisms of both jucies (APC and YM) can be completely inactivated using UV doses from 47.65 to 85.77 Jcm^{-2} with assurance of good hygienic processing. No significant alteration ($p > 0.05$) in titratable acidity, brix, total phenolic compounds and antioxidant capacity. Yeast and Moulds showed higher resistance

to UV-C light compared to bacteria. There is a shadow effect of particles in curry leaf juice for the total inactivation of microorganisms compared to Aloe vera juice. UV-C light found as an alternate non- thermal technique for pasteurization of Alloe vera and Curry leaf ready to serve beverage processing combining with other juice processing techniques.

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Development of Gamma Irradiated Ready to Eat Food to Use in Disaster Relief and Emergency Conditions

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Abstract

Present preliminary investigation was carried out to study the optimum conditions of application of gamma irradiation as a sterilization technique for ready to eat food (Naan rotti and Chicken curry) to use as emergency food during natural disasters.

Naan rotti was prepared mainly using whole wheat flour (atta) while chicken curry was prepared with boneless chicken. The portion size of the Naan rotti was 250 g and the Chicken curry was 100 g in order to fulfill one whole meal requirement. Both samples were vacuum packed in triple laminated packs (12 PET/9AL/100LLDPE) and packaged samples were subjected to gamma irradiation under freezing condition. The irradiation doses used for naan rottie and chicken curry were 6 kGy, 10 kGy and 10 kGy, 15 kGy respectively. The unirradiated samples (0 kGy) were considered as controls.

The percentage moisture, crude protein, fat, fiber, ash, carbohydrates and energy values of naan rotti were 34.63±0.39, 11.51±0.41, 0.01±0.00, 0.72± 0.07, 2.23±0.00, 50.9, 2327.33 kcal/kg while that of chicken curry were 75.12±0.41, 18.32± 0.03, 2.98±0.03, 0.35±0.01, 2.68±0.01, 0.55, 1142.28 kcal/kg respectively. No significant change ($P > 0.05$) was observed in water activity, protein content, vitamins (B3, B6), and sugars (sucrose, fructose, glucose) of naan rotti due to gamma irradiation. However, starch content and amylose content were

significantly different ($p<0.05$) in irradiated Naan rotti compared to control. Appearance and colour values (L, a*, b*) were not significantly different in irradiated naan rotti compared to control while texture (hardness), taste, mouthfeel, after taste and overall acceptability were affected by gamma irradiation. In chicken curry, pH, water activity, odour and vitamin B3 were not significantly changed ($P >0.05$) even though acid value and peroxide value were significantly increased ($p<0.05$) in gamma irradiated sample compared to control. Microbiological study revealed that the irradiated naan rotti and chicken curry were completely sterile and suitable for human consumption.

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Use of FT-NIR Technique to Determine the Iodine Value of Edible Oils

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Abstract

Iodine value (IV) is the indication of degree of unsaturation of fatty acids associated in edible oils. The current international methods (AOAC and ISO) of analysis of iodine value are based on titration methods and are time consuming and laborious. Because of hydrophobic nature of edible oils, organic solvents are essential as the reaction medium, thus these classical analytical methods uses high amounts of organic solvents, resulting high cost, environmental and health impacts. NIR techniques are environmental friendly and do not accumulate any hazardous chemicals. Virgin coconut oil (VCO), copra coconut oil (CCO), desiccated coconut oil (DC) samples and other commercial vegetable oil samples (palm oil, sunflower oil, sesame seed oil, olive oil, soya been oil and corn oil) were used for the method development. Iodine value (IV) was determined by ISO 3961:2013(E) in terms of grams per 100 g of oil. All the chemicals and solvents used were of analytical grade. Near infrared spectra for all above mention oil samples were obtained by FT-NIR (Antaris II, Thermo Scientific) in the wavelength range of 4776-4555 cm^{-1} in resolution of 4 cm^{-1}, accumulating 36 sample scans and back ground scans per spectrum. Partial least square (PLS) calibration (TQ analyst version 9 software) was done by feeding wet analysis results and validation was done by full cross validation. The obtained calibration model was used for quantification of unknown samples.

In the above mention range significant spectral variation could be observed. It may be because of CH combination due to unsaturations. Upon PLS calibration, correlation coefficient (R^2) between actual and calculated values of 1.00 and Root Mean Square Error (RMSE) of 0.16 were reported. Validation was done by leaving one sample at a time and obtained 0.99 R^2 and 0.47 RMSE. Prediction of unknown

concentrations was done using the above calibration curve. For the three unknown samples with 6.21±0.001, 10.05±0.001, 6.25±0.001 (mean ±SD) wet analysis results, predicted values from PLS calibration are 5.88, 9.58 and 5.95 respectively. The predicted values are well correlated with the wet analysis results. Results revealed that the model works well for the unknown samples and could be used to predict the iodine value of edible oils.

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DSP Based Enviromental Monitoring System

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Abstract

Maintaining temperature and humidity within an acceptable range is essential process in an accreditation laboratory. When a calibration is done according to a calibration procedure, the ambient temperature and humidity must be mentioned in the calibration data sheet and the calibration report. Therefore, those two parameters needed to be monitored precisely. Currently in the Industrial Metrology Laboratory (IML), OAKTON-Hygrothermograph paper based system is used to monitor those two parameters. The resolution of the existing system is 1°C & 1% for the temperature and the humidity respectively. An automated data logging system is developed to achieve higher accuracy and convenient data reading.

The data acquisition is done by using NI cDAQ-9174 data acquisition device. Two Omega EWSE – PT100 4-wire temperature sensors of accuracy 0.1°C and Omega HX-71 MA Humidity sensors of accuracy 4% were used as sensor modules.

A graphical user interface (GUI) was developed using LabVIEW 2015. The GUI allows user to configure the data acquisition settings. In addition, acquired data can be monitored in real time, save and retrieve through the GUI. Calibration of each temperature and humidity sensors of the laboratories can be done using this interface. Digital signal processing techniques such as moving average filters are used to increase the accuracy of the system. By using this system, temperature and the humidity data logging can be done with 0.1°C & 4% accuracy respectively.

This system can be introduced to other laboratories which maintain temperate and humidity and it can be used as a calibration method/ technique such as retort calibrations.

FTIR Analysis for Reduced Graphene Oxide/ MnO_2 Nanocomposites for Energy Storage Applications

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Abstract

Graphene is a superior material when compared with other traditional materials due to its excellent electrical, thermal and mechanical properties. Many prominent applications, especially energy storages can be developed using graphene based materials such as Graphite oxide (GO). Graphite oxide (GO) can be synthesized from natural graphite which is available at Kahatagaha mine in Sri Lanka using the modified Hummers method and reduced graphene oxide (rGO) was synthesized incorporating hydrothermal method. A developed material composite containing reduced graphene oxide (rGO) and metal oxide can achieve excellent conductive property and will reduce large surface area. In the present study, manganese dioxide (MnO_2) with reduced graphene oxide (rGO) was synthesized to develop composites to use in the development of supercapacitor electrode material. Different concentrations of composite materials were analyzed by Fourier-transform infrared spectroscopy (FTIR), suggesting a pseudo capacitance in super capacitor electrode materials.

The FTIR spectra of different concentrations of rGO/MnO_2 ((1)-8%, (2)-6%, (3)-4%, (4)-2%) composites and (5)-GO found that different types of oxygen functionalities are present in GO confirming various oxygen configurations. The band around 3220 cm^{-1} is attributed to free hydroxyl (C-OH) from water vapor and that peak was seen reduced when GO becomes rGO especially at (1) 8% rGO/MnO_2 and (3) 4% rGO/MnO_2.The ketonic species (C=O) can be seen at around 1722 cm^{-1} which the peak was reduced at increasing concentrations of $KMnO_4$. Thermal reduction process is used to reduce GO to rGO and related sp^2

hybridized C=C peak is observed around 1625 cm^{-1}. The said sharp peaks can be seen at (2) and (4) very clearly. C-O and epoxides (C-O-C) functional groups can be seen at around 1100 cm^{-1} and 920 cm^{-1}. The Mn–O-Mn bond vibrations could observe in each composite at around 610 cm^{-1}. 8% Therefore rGO/$KMnO_4$ and 4% rGO/$KMnO_4$ composites can be regarded as highly chemically bonded depending their functional groups and has to verify with other analytical methods. Further research is underway to analyze above composites using Scanning Electron Microscope (SEM) and X-ray diffractometer (XRD) to investigate as aprospective electrode material for supercapacitors.

Headspace Characterization of Hexanal Incorporated Composite Material (HICM) for Postharvest Application on Mango Fruits

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Abstract

The HICM was designed to slow release the hexanal into packaged fruits in order to extend the storage life. Hexanal Incorporated Composite Material (HICM) was developed by adding hexanal in to a matrix consisting of banana pseudostem fibre, synthetic and natural polymers. The headspace GCMS study was conducted to determine the fate of hexanal vapour after releasing to the fruit container. Freshly prepared composite material (1.5 g) with and without mango fruits were transferred into a 1650 mL air tight glass bottle and headspace gas (0.5 mL) samples were drawn from the bottle via a septum fixed to the lid. Each treatment consisted of three replicates.

Head space concentration of hexanal released from HICM was calculated and found to be initially $3.64 \times 10^{-7} \pm 0.77 \pm 10^{-7}$ mol dm^{-3} and reduced to $2.09 \times 10^{-7} \pm 0.71 \pm 10^{-7}$ mol dm^{-3} of headspace air at day 7. Headspace GCMS study revealed that hexanal is naturally released as an aroma compound of TJC mango. Slowly released hexanal from HICM was absorbed into fruit and converted to aroma compounds such as Ethyl hexanoate, Hexyl acetate etc. An oxidative and reductive reaction happens after absorbing slowly released hexanal into the fruit and was identified by analyzing of aroma compounds.

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Suppression of Water Hardness using Red Clay

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Abstract

Water hardness is the total value of dissolved calcium and magnesium in the water. The hardness in water is mostly naturally occurring in groundwater with weathering of limestone, sedimentary rock and calcium bearing minerals. They are also present locally from industrial effluent such as chemical and mining industry or the excessive use of lime to the soil in agriculture field. In Sri Lanka, most of the low land areas in dry zone naturally consist of considerable hardness in water. Hardness in water is not accepted mainly due to unpleasant taste and aesthetic concerns. Moreover, one suspicious course for kidney failure issue in Sri Lanka is water hardness. Therefore removal of hardness from drinking water is very crucial.

The present study attempts to use red clay for removal of hardness in drinking water. Clay with different experimental conditions was investigated. The results indicated that the average total hardness can be reduced up to 48.05%. The removal of Ca^{2+} and Mg^{2+} hardness were 45.23% and 53.84% respectively. With repeating filtration, the total hardness removal efficiency was gradually deceased. Removal of Ca^{2+} hardness was predominantly decreased and Mg^{2+} hardness was observed to remove by about 50% only. With the results it can be concluded that the water filter has to be further modified to be used as for the domestic use. Red clay based modified clay filter has higher hardness removal ability. Materials which are used for manufacturing of filter had to be modified to increase long term usage and higher efficiency.

Analysis of Consumers' Purchasing Decision Making of Mangoes through KANO Model

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Abstract

Selection of good quality mango fruits from the market is a difficult practice and probability of getting low quality fruit is common by experience. Therefore, the objective of this study was to evaluate the consumer's mindset on mango fruit purchasing related decision making criteria through KANO model. Use of similar pattern of Kano model was used as a tool to investigate the inherent customer's thinking pattern on the product or service characteristics. Identified decision making criteria can be used as important quality characteristics of mango fruits. The question pair is formulated as a "trick" to investigate customer "black-box" on purchase decision making process.

Ten important quality characteristics were identified by interviewing fifteen mango consumers. According to their responses, KANO model questionnaire was developed and responses of 30 subjects were collected through Google Forms® online questionnaire. Based on KANO model analysis, on consumer decision making characteristics related to purchasing of good quality mango revealed that, free from pest infestation (DDI = - 0.75) and spoilage (DDI= - 0.7333) were the parameters played major role in consumers' decision making for choice of good quality mango. Fruit size, colour, aroma, stage of ripeness and price were given lesser impact on purchase decisions when compared with DDI values obtained, though it was categorized in the attractive category. Therefore, if these two criteria matched with customer's expectation, it resulted with a higher satisfaction. Fruits which are free from physical injuries, spoilage, pest infections are commonly identified as basic criterion for selection of good quality mango. Fruit price is considered as a basic requirement but it also had attractive feature upon selecting

good mangoes. Findings from the study proposed the use of KANO model, by both sellers and buyers on selection of good fruits. Quality based transparent pricing scheme can also be imposed by the quality parameters identified by the study.

Quick Easy Cheap Effective and Safe (QuEChERS) Method for Analysis of 25 Pesticide Residues in Soils - Validation of LC-MS/MS Centered Multi Residue Method

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Abstract

Residues of pesticides are remains left in diverse matrices such as water, food, agricultural commodities and animal feeds resulting from the use of pesticides. At present, Sri Lanka is known for using higher levels of agrochemicals, consequently attribute for residues in agricultural lands. Hence, contamination risk of pesticides associated with water bodies and soils are significant. Therefore, the development of a rapid multi-residue method of analysis that can simultaneously determine a wide range of pesticides is essential towards achieving the goal of a toxins free country. Extraction of pesticide residues from soils is a longer and multistep process due to the complex nature of the matrix. The aim of this study was to evaluate the effectiveness of the QuEChERS extraction method for the analysis of pesticides in soils and validate the method if it was found to be effective. Twenty five pesticides comprising various chemical characteristics were analyzed after extraction and purification with QuEChERS method, by Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS) with Electro Spray Ionization (ESI). Separation was done with a reverse phase C-18 new generation column. Linearity of the mass detector was found to be 5 to 100 µg kg^{-1} and, correlation coefficient of 0.998 or above was recorded for all the pesticides. Mean recoveries of most of the pesticides were in the range between 70% to 130% and this is in compliance with the SANCO guidelines. The limit of determination (LOD) was 0.01 mg kg^{-1} for all the analytes. This method exhibits a good repeatability for all 25 pesticides by having RSD values less than 10 %. The use of QuEChERs method for the

analysis of pesticides in soils proved that the method provides good recoveries, accuracy and minimum matrix-effect related errors. A highly efficient and rapid multi residue method with secondary confirmation for pesticide residues in soils thus, has been validated.

Fluidized Bed Coupled Vacuum Heat Pump Dryer for High Value Dehydrated Food Production- A Conceptual Paper

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Abstract

Short duration of drying at low temperature, oxygen free and aseptic condition is required for dehydration of high value products. Vacuum drying shows high moisture extraction rate by maintaining boiling point of water in the product under vacuum and removal of water by vacuum. Heat pump retrieves the heat in the exhausted air and delivers more heat than the work input to the compressor shows high energy efficiency while controlled drying under low temperature and providing aseptically drying in a close loop mode. Application of heat pump in vacuum drying gives access for lower specific moisture extraction with aseptically and oxygen free drying and provisions of cooling arm for low temperature storage of products and for the processing area. Fluidization is the state at which all the particles comes in the suspended thereby providing large contact surfaces for the heat transfer to the drying materials. Fluidization achieves uniform temperature distribution, better effect of heat transfers, short drying time and minimum variation of moisture in dehydrated products. The advantages of heat pump dryer and vibrating fluidized bed drying can be combined with the advantage of vacuum pump drying in a fluidized bed coupled vacuum heat pump dryer to produce high value dehydrated products.

LC-MS/MS Method Development and Validation for Ethephon Residue Analysis in Fruits

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Abstract

Ethephon is widely used for artificial fruit ripening in Sri Lanka. However, the decomposition byproducts of ethephon can cause adverse health effects. Also, it is important to fulfill ethephon maximum residue level (MRL) requirements for fruits that are exported. A liquid chromatography-tandem mass spectrometry (LC-MS/MS) method, which is one of the most sensitive and specific for pesticide residue analysis, is developed and validated for residue level analysis of ethephon in fruits. The modified QuPPe method which was developed for analysis of pesticide residues which are very polar and non-QuEChERS-amenable was used for the extraction. Chromatographic separation was attained using gradient elution and MS/MS was operated with electrospray ionization (ESI) probe in multiple reaction monitoring (MRM) mode in negative polarity.

In method validation, specificity was ensured by comparing the MRM ratio of quantifier /qualifier. The working range of the method was 0.1 – 10.0 mg/kg. The linearity obtained at six concentration levels from 5-100 ppb was 0.995. The precision was evaluated by repeatability and reproducibility studies at three different spike levels, low (20%), mid (50%), and high (80%), covering the range of working standards and the Relative Standard Deviation (RSD) at each spike level were between 0.10-0.05. Recovery percentages at each spike levels were 112 % for low, 92 % for mid, and 91 % for high levels respectively. The accuracy of the method was assured by participation in a FAPAS proficiency test (PT) program under PT scheme 19218 and satisfactory results with a Z score of -0.6 was obtained for the reported value. The method has low LOD and LOQ values which were 0.08 mg/kg and 0.10 mg/kg respectively. The method was found robust over different

types of matrices of fruits possessing different acidities represented by pineapple, different water contents represented by guava, and the highly pigmented complex matrix represented by grapes respectively. The percentage expanded uncertainty calculated with a coverage factor of 2 (k=2) was 11 % for ethephon analysis.

The developed LC-MS/MS method is reproducible and accurate, allowing determination of ethephon residues in fruits over a wide range of matrices and comply with the international method validation guideline requirements available for pesticide residue analysis.

Variation of Free Amino Acid Profile among Selected Traditional Rice Varieties (*Oryza sativa* L.*)* in Sri Lanka Cultivated during 2016 Maha Season

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Abstract

The study presents the variation of free amino acid (FAA) content in seven selected traditional rice cultivars; Masuran, Godaheenati, Suduheenati, Pachchaperumal, Soodurusamba, Dikwee and Suwandasamba grown in Bathalegoda and Bombuwala during Maha season 2016. The rice cultivars were selected based on their claimed health benefits and the acceptability scores among the consumers. The FAAs in rice were determined by a validated method using Liquid Chromatography-Tandem mass spectrometry (LC-MS/MS) in the electron spray ionization mode.

The total mean FAA levels among the cultivars ranged between 16.3 mg/100 g to 48.3 mg/100 g. A significant variation ($p<0.05$) was observed between the two locations among the overall FAA profiles of the studied rice cultivars except for aspartic acid and histidine. Among the FAAs, aspartic acid, glutamic acid, asparagine and alanine were the FAAs with relatively higher levels while, methionine, hydroxyproline and glutamine being the least FAAs observed in all the cultivars. Further, discriminant analysis done based on the FAA profiles indicated that, among the seven rice varieties, Soodurusamba, Suwandasamba and Masuran were grouped in three different clusters from the rest of the cultivars exhibiting unique FAA profiles while Suduheenati, Pachchaperumal, Dikwee and

Godaheenati were closely clustered suggesting the possibility of possessing either similar genetic background or sharing of similar FAA accumulation mechanisms.

The present study provides important reference to find the relationship among FAA profile, taste and health claims reported in the traditional rice cultivars and provides an insight to the consumers, nutritionists and rice breeders to identify varieties to be popularized in the future for consumption.

Room Acoustic Analysis to Enhance the Speech Intelligibility of a Discussion Room

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Abstract

In auditoria used for speech, such as lecture halls, theaters and discussion rooms, the influence of the acoustics on speech intelligibility is a predominant issue. The existence of poor speech intelligibility in a discussion room of Industrial Technology Institute (ITI), Malabe has become an inevitable problem for the current users. This paper describes the applicability of the method used in this study to develop room acoustic design for the discussion room of ITI, Malabe to enhance the speech intelligibility. ODEON 13.02, room acoustic modeling software was used to develop the room acoustic design. To collect existing background data, room acoustic measurements were done according to the ISO 3382 standard using the measurement system of ODEON software and sound analyzing instruments of BRUEL & KJÆR. The measured room acoustic parameters of the discussion room imply that the Speech Transmission Index (STI) values of the existing room are in the range of 0.5 - 0.6 which is considered as "fair" in the subjective scale of the STI. The simulated results of the developed room acoustic design of this study with the acoustic treatment implied that STI values could increase approximately from 0.5 – 0.6 to 0.6 – 0.8 which is considered as "good" and "excellent" in the subjective scale of the STI. Hence, it is fair to assert that the method developed in this study for measuring and modeling room acoustic properties, fulfills its main function that is the ability to enhance the speech intelligibility of the discussion room.

Prediction of Noise Impact due to Port City Development Project with Noise Mapping

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Abstract

According to the Megapolis master plan 2015 the Sri Lankan government started the Port City development project as one of the major mega scale development projects. For the environmental impact assessment study of the phase II development stage, predicting noise levels induced by future construction activities and the operational stage of the project are very important. To model the above situations IMMI noise mapping software was used by considering the acoustic phenomena like multi-reflection, absorption and diffraction when noise is propagating.

The predicted traffic data and construction phase data including structural orientations of the newly formed land was used to build the noise model and predict the noise level to the sensitive locations at the vicinity of the port city development project site. From the noise model, the major noise sources which affect the identified sensitive locations were identified. From the model it was revealed that, the noise generated from the port city activities during either construction stage or the operation stage does not affect sensitive locations. Further it was noted that the sensitive locations were mainly affected by high traffic noise from nearby roads.

Efficient Use of Desktop Computers in Workplaces

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Abstract

Computes are widely used in workplaces all over the world to perform day to day office work more efficiently. In Sri Lanka, use of information and communication technology is increasing since year 2000. Government, Semi-government, and private organizations tend to use computers to uplift their service capacity. Organizations spend a lot of money on high-end computers without considering the main purpose of use of them. A proper study of the process usage of desktop computers in Sri Lanka has hitherto not received much attention.

Therefore, a network based process measurement programme was developed to measure the processor usages. Research finding showed that desktop computers were underutilized. Network based processor utilization measuring programme and recommendations to optimally use processing power of desktop computers in workplaces were outputs of this research.

Identification of the Information Needs of the Local Cereal Based Industrialists and the Perception on ITI and ISC using CSFS Approach

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Abstract

The main objective of the research was to identify the information needs of local cereal based product industry using the Critical Success Factors (CSFs) approach. The perception on ITI and ISC were the additional outcomes of the research. This qualitative study was exploratory in nature and it employs the case study methodology. In-depth interviews, using an interview guide, were used to collect data employing the purposive sampling method. Scope of the study was limited to the cereal based product industry (cake, biscuit, breakfast cereal etc.) excluding paddy as rice and bread. Eight companies were selected and from each company, managers representing General Management, and Production/Research and Development and Marketing divisions were interviewed. 'Pattern matching' and 'Explanation building' were the data analysis methods used.

Five CSFs were derived and they were (1) Creating awareness; (2) Collaborations; (3) Developing expertise (4) Information and (5) Recognition of ITI. The CSF; Creating awareness about consuming processed cereals is important as it is not a part of the Sri Lankan food culture. All stakeholders such as supporting services, raw material suppliers, and the government must collaborate in order to develop the cereal market. There is gap to be filled in training the personnel in local cereal industry. Information, itself is a CSF which has an effect on all the other factors. ITI test results were considered by the industrialists as highly accurate and acceptable; however, expensive, while most of those industries are not aware about ITI information service.

The findings of the study are useful to the local cereal product industrialists to clearly identify their information needs and for information providers and

researchers to provide the exact information to the industrialists and for the development of the industry. Perception about ITI can be used to carry out developmental changes of ITI.

Usage of Information Services Center of ITI for Information Requirements of ITI Staff with the Evolution of Information Technology from 1983 to 2015

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Abstract

In modern world information technology plays a major role and has a huge impact on libraries and information centers in particular. Information Services Center (ISC) of ITI is an ideal example of using the development of information technology in Sri Lanka's special library sector over the past 30 years. The paper is based on user surveys carried out by ISC from 1983 to 2015.

In 1980s, a dictionary type card catalogue was the main information locator. According to a mini-survey carried out in 1983, 86% of the staff members visited ISC frequently. However, 36% were unable to locate information material with ease. The computerization process of ISC was started in 1986 with a micro computer and became the first library to computerize information services in Sri Lanka. Then in 1989 ISC moved to the minicomputer system with a partially customized library package. From 2002 ISC subscribed to several scientific databases as well. As per the user survey 2003, 48.3% of the staff claimed visiting ISC, and this was half the number of 1983. In 2003 the most important sources of information for ITI staff were books, journals and standards. However, 78% of respondents were not aware about on-line databases and 37% did not use the Internet during that period.

Internal User Survey-2007 showed further decrease in staff library visits (30%) with the introduction of an "Automated On-line Library System". From 2003 to 2007 a remarkable increase was observed in the usage of on-line databases, CD-ROMs, on-line patent databases and web based library catalogue as 76.7%, 67.5%, 60.4%, 73% respectively.

Currently ISC is equipped with modern ICT tools and the internal user survey 2015 showed approximately 15% of the staff visiting ISC once a week and 40% of them visiting ISC less than once a month. Also staff showed 60% satisfaction for the printed collection of ISC with a same percentage of satisfaction with on-line resources.

Changes shown by ISC over the past 30 years proved that information technology has raised the library to a higher level and exposed the information sources to a wider user base. Further, usages of computer based information services have improved, though the frequency of visits to the center reduced.

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